

**Interpretation through emergence: reconstituting the lost complexity of the late  
Neolithic/Early Bronze Age cosmovision by multi-disciplinary method.**

PhD (by publication and production)

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## Abstract

This PhD by publication and production represents some of the published outputs of a research project in interpreting some monuments of late Neolithic and Early Bronze Age (EBA) in NW Europe. In the course of this project it became clear that it is necessary to integrate a number of methodologies that presently are mainly conducted in isolation – behavioural ecology, social and cultural anthropology, archaeology and archaeoastronomy. This integrated methodology required not just a new way of conducting field work, but also a new interpretive method that requires analytically reconstructing the prehistoric monument building cultures. This interpretive method is based upon a return to ‘system theory’ through and taking with it many of the assumptions of post-constructionist thinking. I call this method - ‘re-emergence’, and its rationale and application are justified and explained in the Critical Review and in the published papers. Over the course of the past decade during which I have developed and applied these methods, I have simultaneously developed and tested a theory of ‘lunar-solar conflation’. This theory locates the monument building cultures of late Neolithic/EBA NW Europe as both a continuation and reversal of their Palaeolithic/Mesolithic forager forebears. At Stonehenge this is exhibited by cattle pastoralists confiscating Palaeolithic ritual entrainment upon monthly dark moons by substituting dark moon rituals which coincide with the solstices twice every nineteen years of the draconic cycle. The published papers of this PhD constitute the evidence and tests for this new theory. Early in this research programme, and quite coincidentally, a film production company approached me to make a film on Stonehenge commissioned by National Geographic based upon my research. As I became the main participant, consultant and script writer for this film it is included as the ‘production’ part of my PhD.

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## Dedication

I would like to dedicate this PhD to the memory of my father Bernard Leonard Victor Sims and to my mother Winnifred Bertha Allen.

## **Critical Review**

## **Critical Review**

### **Introduction**

This research project came out of a long term concern with the origins of inequality which was re-awakened by my work circumstances at the University of East London in the early 1990s. I was one of a staff team in the new B.Sc.(Hons) Anthropology programme exploring a model of cultural origins developed by three of our staff - Chris Knight, Camilla Power and Ian Watts (Knight 1991, Knight et al. 1995). Using neo-Darwinian methods of calculating the cost-benefit ratios of the reproductive outcomes of a range of survival strategies, this model suggested that our African hunter ancestors had lived in egalitarian relationships in matrilineal-matrilocal clans. My research interest was in the limits to this model. In particular, could the collapse of the optimum conditions for this model help us locate the source, shape and content for the first social inequality? The model felt particularly promising to assist such a research project since it predicted a large suite of unusual, precise and testable attributes for the first human society. Since unusual and precise predictions are easier to refute than trivial and vague predictions, then they should feed into equally testable and precise predictions for the origins of social inequality. I therefore began my research into inequality by engaging with this model of a primordial equality.

'Sex-strike' theory suggested that Palaeolithic sub-Saharan African female coalitions, in concert with their matrilineal classificatory brothers, adopted seclusion strategies to motivate men in other matrilineal clans to provision them with hunted meat. Seclusion would be signalled and achieved with menstrual synchrony during the dark moon phase of the month. A collective hunt of mega-fauna was scheduled to be successfully completed by the light of the full moon, and the seclusion rules would then be relaxed once the blood of the surrendered game had been removed by cooking back at base camp. During the waxing period of the month leading up to full moon, women and men would shed those aspects of themselves denoted by biological gender as wives and husbands, and commune amongst their blood kin. To those outside their matrilineal clan they became a collectivised anti-marital unity. Without assuming language the model predicts that women would reverse the signals of an animal mate recognition system. All animals must ensure that they have chosen the correct species, sex and time when seeking a mate. Only humans can in masquerade performance represent themselves as animal, gender

ambiguous and bloody. Females signalling wrong species, wrong sex and wrong time would in ludic, carnivalesque mode be able to discriminate against those jealous covetous males not willing to join in the joke and therefore meet the terms of the women's coalition. This constitutes a performative theory of gender in which females and males as siblings construct themselves as gender ambiguous to temporarily separate themselves from their partners in other matrilineal clans. It predicts that gender is socially constructed as 'the gender of power', whereas 'normal' sex-gender in which we are our biological selves, is weak gender. For a culture organised around a sacred waxing half alternating with a profane waning half, the gender of power predicts that the sacred domain is populated by therianthropic, gender-ambiguous bloody beings.

If this model is valid, then these attributes of sex-strike theory should translate into hypotheses informing the emergence of inequality. When my research began in earnest I was unsure how this might be. Rather than any precise research agenda, all I had to go on was a very strong hunch that with the collapse of Palaeolithic hunting equality then this would lead us to expect a sense of loss, and that post big game hunting cultures would display some complex swan-song of transition. I also suspected in the vaguest of ways that included in this transition would be issues that touched on economics, gender and 'astronomy'. Practically it began in 1992/3 during a sabbatical year granted by the School of Social Sciences at UEL. In that year I followed a Masters course split between the Institute of Archaeology and the anthropology department at UCL, where I studied the current research into the emergence of social complexity. Sensitised by my studies at UCL, my thoughts came to focus on the monument building cultures of Neolithic north-west Europe. I was particularly struck by the lack of integration between anthropology and archaeology into the origins of social complexity. One sub-discipline in particular stood at the centre of this intersection yet itself was in disarray – archaeoastronomy. I focussed on a multi-disciplinary research project into the monument building cultures of the Neolithic in the British Isles, with particular reference to the 'astronomy' of the monument complexes of Avebury and Stonehenge in Wiltshire. In the course of this project I had to develop a new method that considered buildings and landscape as particular choices in a virtual world of limitless choices, a multi-disciplinary method of 're-emergence', and a new theoretical model of lunar-solar conflation to overcome key weaknesses in all three disciplines. This Critical Review



explains what prompted and what justifies these initiatives during the course of offering my research papers for publication.

### **Archaeoastronomy**

Beginning my research from the expectations of sex-strike theory I knew that I had to consider the economics of the shift from hunting to agriculture, the sexual politics of gender relations and the 'astronomy' of ritual action. I therefore had to immerse myself in the archaeology, anthropology and archaeoastronomy of these issues. A stimulant to this agenda occurred in 2001 when I read a paper in the *Journal of the Royal Anthropological Institute* by Chris Tilley, the landscape phenomenologist, in which I took exception to his particular use of post-processualist methodology. I already knew Chris Tilley from my Masters course at UCL, where he taught a module on ancient monuments. It was during this course that he made it clear to me that he thought it extremely unlikely that Neolithic monument builders would have possessed the knowledge to map lunar movements into the design of their buildings. I was surprised at his underlying assumption of the primitivism of the builders. I wrote a short response to his paper in which I criticised his ad hoc selection of features of the prehistoric monuments on Bodmin Moor, his idiosyncratic characterisation of them as 'art installations' and a definition of landscape which could not include skyline (Sims 2001). However at that time I could not back up an essentially negative critique with a more positive agenda.

Spurred by this experience and with another semester break from teaching and management duties in 2003 I began my research in earnest into prehistoric 'astronomy'. As I began by reading Hawkins (1970) and Thom (1971), I was initially convinced that eclipse prediction must have been part of the monument builder's culture. This was not because I agreed with their view that ancient astronomer priests built these monuments as precision 'scientific observatories' and 'computers'. Instead I started from the assumption that a lunar scheduled cosmology or religion would have great interest in avoiding a lunar eclipse<sup>1</sup>. While solar eclipses are rarely observed for any one point on the earth's surface, lunar eclipses can be seen on one half of the earth three or four times a year. And while solar eclipses, albeit rarely seen, take place at dark moon, lunar eclipses of course always take place at full moon. Looked at as a digital signal an eclipsing sun only takes place when the moon

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<sup>1</sup> Priests in ancient China were decapitated if they failed to predict an eclipse.

is already 'eclipsed' while an eclipsing moon is a full moon that is being negated. A solar eclipse is therefore an amplified signal whereas a lunar eclipse is a reversed signal. Any preparations for a full moon ritual are therefore catastrophically undermined by its eclipse. I was soon to be disabused of this assumption. When reading John North (1996), I was dismayed to read his strident but unexplained rejection of eclipse prediction theory at Neolithic monuments. The answer was hidden away elsewhere, in the writings of Professor Thom (Thom 1971). Thom shows that if you have knowledge of the nineteen year cycles of lunar standstills then that knowledge will always include an understanding of eclipse cycles which during a standstill year can only take place at the equinoxes' full moons. A monument like Stonehenge aligned on winter solstice during a lunar standstill guarantees the integrity of the lunar phased rituals by avoiding eclipses. Therefore instead of Stonehenge being a lunar eclipse predictor, it is a lunar eclipse avoider. However John North's description of lunar standstills as mapping those very same tiny perturbations of the moon's movements<sup>2</sup> which account for eclipses made no sense in the light of his aversion to eclipse prediction theory. I then turned to other scholars in the discipline. The work of Hawkins and Thom caused a storm of controversy with archaeologists and archaeoastronomy as a discipline had to take stock of the criticisms (Michell 1989). The generation of researchers that emerged from this strident debate presently lead the discipline and its umbrella organisation, The European Society for Cultural Astronomy (SEAC). It is now in its third and unsure stage of scholarly evolution, still hesitatingly dealing with the outcomes generated from its debate with archaeology. Heggie (1981) showed that Thom had not been rigorous in his selection of monument features to test whether any alignments existed and recommended more robust selection and testing procedures. In this vein Ruggles (1999) conducted a major fieldwork exercise studying five regional groups of monuments in the British Isles, each group following an identical design. Using statistical method he tested whether any alignments found could be explained by chance variation alone. His conclusion was that it cannot be an accident that all of these monuments displayed alignments on the sun's solstices and the moon's standstills. And after four decades of review, there are signs of some

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<sup>2</sup> An accuracy of one-tenth of one degree is required.

archaeologists now engaging with the 'astronomical' dimensions of ancient monuments (Parker Pearson 2006).

Reading these and other researchers in archaeoastronomy I was reassured by the scholarly level of the discipline, but I had two problems. First, the explanations given for the meaning of monument alignments on solstices and standstills were not convincing. Second, I had chosen to study the unique monuments of Stonehenge and Avebury, and here a statistical study of groups was not possible. I had reached the limit of the re-launched discipline of archaeoastronomy. In my research the earlier modelling exercise led me to make certain precise predictions concerning the prehistoric monuments of the Neolithic British Isles. In particular, we would expect some emphasis on dark moon to be embedded within an estranging dynamic in which lunar properties are being confiscated and appropriated in some process of social reversal. On first engaging with archaeoastronomy I found no such evidence or support for these expectations. Stonehenge was chosen since its iconic status within the scholarly and heritage establishment means it is one of the most archaeologically researched prehistoric sites in the world. If interpretation of prehistoric monuments is possible then it should be here. Within archaeoastronomy there were five extant theories for Stonehenge which claimed alignments for summer solstice sunrise, lunar horizon extremes, forestalled lunar horizon extremes, eclipse prediction and full moon<sup>3</sup>. In my paper (Sims 2006), I demonstrated that not one of these theories could withstand critique.

John North (1996) does not use the statistical method but shows how by paying attention to the details of any one monument reveals peculiarities and extra-numerary items that are unexplained by any model other than an 'astronomical' one. Coming from an anthropological background, for which 'the devil is in the detail', this was to me an attractive approach. At Stonehenge, for example, he showed that extra properties are revealed not by standing at its centre, but in approaching it from the north east along the contemporary feature of 'The Avenue'. Instead of the monument being a stone circle full of gaps surrounding an empty space, walking uphill towards it and alongside the end-of-Avenue Heele Stone, the monument appears as a solid wall of stone except for two small windows one above the other through its central axis. John North demonstrated that the winter solstice sun sets yearly in the lower

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<sup>3</sup> See my 'Solarisation of the moon...' for references.

window and the southern minor standstill moonsets every nineteen years in the upper window. John North then considered these alignments separately and briefly, suggesting that the solar and lunar alignments could be explained by properties intrinsic to each. I show in my paper that this cannot be the case. I asked two questions – are there any emergent properties from the combination of these two alignments, and could the monument have been designed for any other combination of the sun and the moon?

Completely unexpectedly, and in a complete reversal of what all the texts were saying, by carefully plotting the horizon movements of the moon over a nineteen year period (the 18.61 year nodal, or ‘draconic’ cycle), and including the lunar phases and sun’s horizon movements, it was a revelation to me to discover that during the two lunar standstills that define this cycle dark moon *always* occur within the seven days of the sun’s solstices. This had never before been identified in archaeoastronomy. The majority of archaeoastronomers are astronomers or physicists, and for them any alignment on the moon usually means a visible full moon. Instead, I instantly knew how to interpret a dark moon alignment ethnographically – since this is always the time for what Levi-Strauss has called ‘the instruments of darkness’ to announce magic, death and resurrection and all aspects of ritual power to be mobilised (Levi-Strauss 1986, 286-8). It was also consistent with the prediction of sex strike theory that sacred power operates during waxing moon between dark moon and full moon. But with lunar standstills it is not just dark moon – it is dark moon displaced onto a solar cycle by observing the moon indirectly as a horizon *alignment* rather than naturalistically as a phased moon when observed during any part of its transit in the sky.

As shown in my paper a significant suite of properties do emerge along the main axial alignment at Stonehenge when viewed from the Heele Stone:

1. Winter solstice sunset for seven days in the lower window every year.
2. Dark moonset coinciding with winter solstice in the upper window every 19 years.
3. The two above in combination generate the start of the longest darkest night every 19 years<sup>4</sup>.

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<sup>4</sup> For the axial alignment at Stonehenge. Secondary alignments at Stonehenge include the southern major standstill moonset, which is the second possible ‘longest darkest night’ predicted and delivered by the draconic cycle.

4. While the upper window culminates in dark moon at winter solstice, it tracks the lunar phases over the course of a minor standstill year in a reverse sequence once every 27.3 days of the sidereal cycle.
5. These reversed lunar phases over the course of the whole year sum to thirteen lunar phases which constitute a syncopated but full set of lunar phases displayed in the synodic cycle.
6. These properties in combination create an abstracted, reversed and attenuated annual 'month'.

A solarised reversed annualised lunar 'month' would be ideal for the symbolic purposes of displacing and reversing the Palaeolithic moon onto a Neolithic lunar-solar monument alignment. By conflating lunar and solar properties principles of replication and reversal are mobilised which contradict any simple continuation of lunar rituals from a forager past. Nor is this property compatible with a founding cosmology of cultural origins. While a ritual engagement with dark moon that began in the Palaeolithic is continued, it has simultaneously been subverted by Neolithic solar reversal. These were 'astronomical' findings that I never expected, and they fitted the predictions of a collapsed big game hunting cosmology like a glove. As a unique monument, and without the rigour of statistically testing groups of identical monuments, how confident can we be that the builders wanted these properties? In anticipation of this challenge I asked myself that given the resources and knowledge of the monument builders, what other possible Stonehenges could they have built with different double alignments on the sun and the moon? There are just eight possible combinations of the sun's solstices and moon's standstills, and none of the seven other combinations allow a superior setting standstill moon coinciding with the winter solstice sunset. There can be only one other night as dark or as dark and long as this, and that is the other southern standstill of the moon, but now the major standstill, 9-10 years after the minor standstill. It is only this monument's unique and challenging architecture that allows the moon to be seen above the sun through the construction of a clerestory window. From John North's method of seeking the idiosyncrasies of each building I was able to extend his insight by seeing this building as a selection from a virtual population of alternative buildings of same design. This quasi-statistical procedure could thus answer the rebuttal of the individualistic fallacy.

## Archaeology

Astronomy was part of the answer but is this finding consistent with the switch from Palaeolithic hunting to Neolithic agriculture? In Britain this requires an engagement with the archaeology<sup>5</sup> of the fifth to third millennia BC. The master model of this period within archaeology contrasts the 'natural' relations of foragers to the 'civilised' or 'domesticating' relations of agriculturalists. This model, which began with Gordon Childe (1964 [1942]) and continues today in the 'Academy School' (Renfrew 2001), contrasts the lack of 'institutional order' of Mesolithic hunter-gatherers to the rise of social complexity with farmers and their surpluses. According to this view the very limited material culture of foragers marks an early stage of human evolution in which memory and institutional organisation is yet to be stabilised in a store of material objects imbued with symbolic potency. By 'institutional order' Renfrew means the institutions of hierarchy and ownership, which include 'marriage, property, debt and obligation' (Renfrew 2001, 97). The limited material culture remains of foragers is, according to this view, equivalent to a low level of cultural and social organisation and warrants the label 'simple' societies. In contrast my use of the sex strike model locates the source of 'institutional order' in political and economic reversals long before agriculture amongst in the same hunting societies of the Mesolithic and even late Palaeolithic in which Renfrew sees none. My hypothesis is that within the Mesolithic the male monopolisation of ritual power starts to generate through women's exclusion and oppression what will subsequently become the social classes of the Neolithic. This model therefore predicts that social complexity as *inequality* began long before the Neolithic amongst hunter-gatherers of the late Palaeolithic. According to this view foragers are neither 'simple' nor 'primitive'. However, the master model of archaeology makes no predictions for socially complex hunter-gatherers that might be a precursor and precondition for an agricultural social counter-revolution. There is therefore a contradiction between what my model predicts and the master model within archaeology. However, this master model within archaeology has received two strong challenges. The work of Hayden (1990) and Testart (1978, 1988) considers the storage hunter-gatherers of respectively the Amerindians of the North West coast of America and Australasia as examples of hunter-gatherer complex cultures which display

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<sup>5</sup> In America it is four-field anthropology – social and biological anthropology, archaeology and linguistics.

sedentary living, monument building, ritual centres and social stratification before 'agriculture'. According to Hayden's anthropological archaeology further evidence can be found among similar socially complex cultures in the epi-Palaeolithic Jomon culture of the north islands of Japan and of the Levant. This view of prehistory has been recently strengthened with the discovery of the 11,600 year old 'Turkish Stonehenge' built by hunter-gatherers at Gobekli Tepe (Mann 2011), and is firmly rooted in archaeological data concerning the ecological and zoological circumstances for NW Europe (Boyle 2010). The second challenge comes from within archaeology itself. A younger generation of post-modern archaeologists (Tilley 1994, Thomas 1999, Whittle 1996) have criticised 'the Academy School' model. They point to the lack of evidence for sedentary intensive agriculture during the Neolithic in much of NW Europe, and argue that the evidence conforms instead to a highly variable economic mix of cattle herding with continued foraging and occasional planting all allied to a remarkable uniformity of ritual practices. They suggest that the Neolithic monument builders were driven by a deeply conservative sensibility which cherry picked just those agricultural innovations congenial to adapt their Mesolithic heritage to much changed social and economic circumstances. They point out that, in contrast to the agricultural revolution model of the Academy School, Neolithic monument building in NW Europe stopped at precisely the moment that sedentary intensive agriculture began in the middle Bronze Age from about 1,800-1,600BC. Instead of discontinuity with their Mesolithic forager precursors, this more recent archaeological model predicts continuity within change by their Neolithic descendents<sup>6</sup>. We therefore do find convergence around the hypothesis that stratification and monument building cultures began long before sedentary intensive agriculture amongst these anthropologists and archaeologists. It should be noted that this convergence would not have been possible a few decades ago before internal processes within each discipline could bring research to this point. The key assumption of the sex-strike model is economic – it requires the mass plenty of big game animals that could be predictably killed by collective hunting. Once this essential precondition is removed, as it was ten thousand years ago with the global extinction of big game, then we would predict the social relations built upon them would begin to degrade. Gender relations in particular would be

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<sup>6</sup> For a recent and in my view weak critique of this model see Rowley-Conwy (2011).

undermined. The contribution of the new 'British school' of post-processualist archaeologists that the adoption of cattle herding triggered the NW European Neolithic provided the next opportunity for theoretical convergence. The traditional archaeology model assumes that hunters of the Palaeolithic and Mesolithic were unable to stabilise institutions or have the resources to build monuments, while in the second model the Neolithic cannot be understood except as a reaction and accommodation to the hunting rituals and cosmology that preceded it. It sees the monument builders as continuing their forager ancestor rituals, although now modifying them to adapt to a loss of their former egalitarianism and social solidarity. Once the economic underpinning of big game hunting and such bride-service payments broke down at the end of the Palaeolithic, then we would expect a protracted disengagement from the optimum model to a strategy more suited to the changing ecological conditions. By the time of the Neolithic cattle herding would have allowed an entirely new and reversed sex-economy, in which bride-price with cattle would have purchased women as wed-locked wives. According to this model in earlier times women were free to return to their matrilineal kin, and this in itself organised and guaranteed ritual cyclicity to be phase locked with lunar cycles. Now these very cycles are compromised by permanent marriage in which women are patriarchally claustrated by cattle owning husbands. Seen as a contest between two rights – matrilineal solidarity and cyclicity versus patrilineal inheritance and permanent marriage at the expense of wider matrilineal clan claims and community – we would expect this stage of prehistory to be one of social conflict, women's oppression and competing complex cosmologies. One measurable indicator we would predict is that an early engagement with lunar symbolism would be contested and overlain with an alternative appropriate symbolism to confiscate ritual power to the emerging interests of cattle owning patriarchs. In contrast, the Academy School model would not predict an early and complex cosmology before intensive sedentary agriculture. In contrast therefore to the master model of archaeology we would expect to find by the Neolithic a complex and contradictory logic to engage with and simultaneously estrange the lunar symbolism deriving from Palaeolithic time-scheduling of women's seclusion rules. From this integration of anthropology and archaeology, we have therefore generated a new hypothesised cosmological attribute of our lost prehistoric culture which returns us to archaeoastronomy.



## Emergence

The first stage of my research had developed a model by triangulating the predictions of sex-strike theory, the archaeoastronomy of Stonehenge, the archaeology of the Neolithic and the anthropology of pastoralists. By integrating these four models in their combination they reconstruct the lost reality of the monument builders of prehistoric NW Europe. This emergent new model views the monuments' symbolic purposes to be displacing the Palaeolithic matrilineal egalitarian hunter-gatherer moon onto a Neolithic patrilineal elite cattle herder lunar-solar monument alignment. During the process of researching these different models and disciplines I was prompted to make explicit the methodological implications of this convergence.

Constructing models of prehistory is open to the challenge of making up 'just-so' stories. One part of the justification for post-modernism is the defence that every attempt at interpretation, prehistory or not, is always another 'just-so' story. However, some stories are better than others. The more disciplines we can bring to bear on a single problem, then since the personnel, methods and data are in general peculiar to each, the probability of overlap and convergence of three or more disciplines around an invalid hypothesis are extremely slim. We would expect an exponential reduction in the number of false hypotheses for each extra discipline we mobilise around the same problem<sup>7</sup>. Conversely, the less overlap between different disciplines when investigating the same culture, then this should prompt more research to investigate the interesting discrepancy. Traditionally this triangulation by discipline is understood to allow us to test interpretations generated from one discipline by another in the expectation that they will both point to an identical or closely similar finding. The more disciplines we can mobilise around the original interpretation, then the more robust it becomes.

There is another power within this procedure of multi-disciplinary triangulation. With each additional discipline that tests some common component of a prehistoric culture, attributes of this component are in varying degrees different according to the particular lens of each discipline. To the degree to which these attributes are different they will offer an incomplete picture of the whole culture now lost to

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<sup>7</sup> The danger inherent in a multi-disciplinary research project is, of course, dilettantism. The antidote to this is to be subject to peer review from acknowledged scholars in each and every discipline. For this reason I have offered my papers to anthropology, archaeology *and* archaeoastronomy publications.

historical degradation. Yet also to the degree that they are different, and assuming that they were once integrated into a cultural whole (see below), they will each offer only a certain number of ways of being combined with each other to reconstitute that whole. The lunar template of sex strike theory for the Palaeolithic overlaps with the lunar alignment at Stonehenge for the Neolithic. The moon is common to both as identical components. However the attributes of a Palaeolithic lunar template according to sex strike theory are as an accessible global clock to cement a universal coalition of classificatory sisters in egalitarian matrilineal clans. Contrarily the attributes of a Neolithic lunar alignment from archaeoastronomy are as a cryptic horizon sidereal marker to undermine monthly universal rituals by a reversing local dynamic of solarisation. A similar contrast can be drawn when comparing dissimilar components across different disciplines. Archaeology's depiction of the Neolithic as a switch from hunting to pastoralism is separate from anthropology's finding for a deterioration in women's status from bride-service to bride-price societies. Yet considered from the point of view of egalitarian hunting clans both are integrated by finding the common theme of social reversal by privatising cattle owners. Combining the attributes of similar and different components allows a gradual accumulation of a higher level ensemble of attributes that fill out the original picture we had of this component from the first discipline with which we began. In the process of re-integrating the fragments we reproduce the process of emergence itself which first generated the culture. At this higher level they attain the level of meaning unattainable by each discipline which considered isolated fragments of the lost reality of prehistoric society. The degree to which they fill out the original picture will determine by how much we can reconstruct the now lost prehistoric culture. We may accumulate enough attributes to discriminate amongst extant scholarly theories that pivot on these integrated components. If we can reject all but one theory, then the one model that remains has stood the test of this procedure. This is not just triangulation in which disciplines separately point to similar findings, but the integration of a number of disciplines to reconstruct a culture which emerges from the one way to combine separate disciplinary data sets.

This is not empiricism. Archaeology's pattern interpretation of excavated material culture becomes empiricism if it claims that the ritual deposition of materials by the monument builders, drawn from their world, carries the meaning of 'reconstructing that world' (Thomas 1996, 233; Bayliss et al. 2007, 26). Since the materials are

drawn from the world, so the argument goes, then their deposition at monuments must have been the ritual re-enactment of creating that world. Archaeoastronomy becomes empiricism when a solar alignment is interpreted as a calendar marker, where its meaning is limited to its timed recurrence throughout the course of the year. But the multi-disciplinary method of integrating recovered fragments of a prehistoric culture requires dimensions of reversal, manipulation and estrangement to be mobilised to fit the fragments back together. If we find that *only* these processes will achieve the integration of these fragments, then the method has transcended empiricism and has become a *realist* methodology. It is those properties that are not directly amenable to sense perception, the unobservable realities hidden beneath the surface phenomenal form of things, which can achieve the interpretation of the lost collective representations of the monument builders of prehistory. Each discipline can only achieve interpretation at the level of meaning by joining with every other discipline. My research into the West Kennet Avenue at Avebury revealed that instead of the common sense expectation that any avenue should be walked within its course, by combining both the archaeology and archaeoastronomy of the Avenue our 'senses' reveal that the builders intended that it should be walked from the *outside in prescribed directions by lunar section* (Sims 2012a, 2012b). As we will see below, the monument builders were not 're-creating the world' but constructing an anti-world to re-shape a passing world into a new world. They were not marking time to measure the passage of time when they aligned a monument on the horizon sun, but stopping time to make 'time-out-of-time' in an enactment of a transformative journey through the underworld. While the monument builders sense perception saw evidence for the underworld all around them, today our sense perception cannot see it. A realist ontology reveals the collective representations that construct each culture's sense perceptions to 'see' entirely different 'realities'.

### **Supervenience**

This multi-disciplinary method is built on the assumption of culture as a *system* of meaning, not of culture as meanings being continually constructed and negotiated by individual agency. The shift from bride service to bride price in marital exchanges, for example, severely constrains how any individual 'agent' might interpret gender relations. The method that I have so far characterised as 'emergence' assumes the realist assumption that culture is a supervenient system which transcends and constrains the active individuals that by their interaction composes it. Since system

theory has been long out of favour in the humanities, a digression is needed to justify looking at culture in this way, with particular emphasis on the methodological implications this might have for research into prehistory.

Within the humanities system theory is criticised for its dualist ontology, seeing society as driven by groups and collectives when all that exists are individuals (Sawyer 2005). For post-processualist critics it is the multiplicity of intentions and actions of individuals that constitute society, whereas a system perspective is seen to rely on a holist avoidance of these meaningful interactions of individuals. Cultural anthropology finds this emphasis on the small scale interactions of individuals congenial to its traditional aim to reveal the hidden meanings of each culture's values. Since at a brute material level it is true that only individuals, not groups, exist, then a defence of a system perspective must show how group effects can emerge from individuals, be causally constraining upon them, but simultaneously not negate individual agency.

For any open system with dense networks of many agents, the number and type of interactions are immeasurably large. The fluid nature and patterns of these interactions are not reducible to a few or localised parts of the system, but are distributed throughout. In the interconnections of all these parts new properties emerge that is a product of their interaction. Just as in the human brain a qualitative phase transition is achieved in which highly organised complex matter gives rise to non-material subjectivity, so amongst humans the trillions of interactions of millions of individuals give rise to supra-individual emergent realities like institutions and culture. Out of complexity emerges order. While Durkheim argued that these 'social facts' are external and constraining upon individuals, ever since Parson's 1937 critique of Durkheim (Parsons 1968[1937]) we have to explain how the emergence of collective phenomena is based upon but cannot be reduced to individual action. Sawyer (2005) has shown how the new consensus amongst philosophers of mind can be drawn upon to critique the reductionist turn in the humanities. Emergence in complex systems is a relation between two levels of analysis, in which higher level properties supervene upon lower level properties. This is a condition in which if two situations have identical lower level states, then they must also share identical higher level states. However, the reverse is not the case in supervenience. In a complex system changes in lower level states need not result in changes at the higher level. The supervenience relation is asymmetric. Any higher state can be realised by

multiple different lower level states, and these different lower level states need not be related. In the jargon they are 'wildly disjunctive'. Supervenience is therefore not just Durkheim's collective phenomena relabelled, but 'wildly disjunctive multiple realisability' (Sawyer 2005, 68). While these collective phenomena emerge from the lower levels, they do this by transcending the intrinsic nature of components by them taking on new properties resulting from their association and interaction with all other components. Local level rules of behaviour come to create higher level behaviour newly suited to a change in the environment. This transcendence does not abolish reductionism. Since emergence theory accepts that supervenience is compatible with and emerges from lower level properties of the system, reductionism will be able to explain some but not all of the interpretation. But since most system properties emerge from wildly different sets of lower level phenomena, they transcend reduction. Each individual, or component of the system, are changed by their association in the complex whole. To reduce them to their condition before immersion and engagement in the system, as individual units, is to destroy those very properties which are displayed in the new emergent reality. As such all components of that system will in some way be stamped with the overarching meaning of that culture.

Sawyer's account of emergence theory is derivative. For philosophers of mind the unit structure of the brain is the individual neuron, and Sawyer has supplanted 'human' for 'neuron' in applying their concepts of wild disjunction and multiple realisability to the emergent properties of societies. But the individual cannot be the unit of human or even ape social organisation. The unit of human society must be a society smaller than itself and it must include a gender relation, since we exist embodied within gender, not within abstract individuality. This is the only possibility consistent with supervenience, since social living changes the properties of each component 'individual' of a social system. For Durkheim and Comte this smaller society that is the basic unit of social organisation is the family (Durkheim [1895]1964, 81-6; Turner 1986, 113-5; Sawyer 2005, 122-4).

Emergence theory thus leads us back in a qualified way to sex-strike theory. According to this the root unit of social organisation is the consanguine coalition of matrilineal kin – classificatory brothers and sisters who descend from the same line of mothers. Individual meaning and collective representations are constructed within these primordial relationships. Once women's seclusion strategies come to conflict

with the post-Palaeolithic necessity to continue hunting irrespective of the phase of the moon, then matrilineal/matrilocal organisation begins to degrade. For women the seclusion waxing part of the month withers away or becomes forbidden, whereas the available waning part of the month expands or becomes permanent. Women become available for permanent marriage – monogamous families. For wider coalitions to survive the breakup of these matriarchal relations, then monogamous families would have cohered within wider relations of co-operating men that would have mimicked in various ways the previous leadership roles of women in the matrilineal clans. While for Durkheim and Comte the family is the basic unit of society, for sex strike theory monogamy is the basic unit of gender-oppressive civilisation. Monogamy emerged from the degeneration of the matrilineal/matrilocal clan once big game scarcity introduced material determinism within social relations.

### **Re-emergence**

With the concept of supervening emergence we have a scholarly foundation for combining both the individual and collective levels by which culture is created as a system of meaning. A prehistoric culture will have left fragments of these meaningful components for us to study. Each discipline that specialises in aspects of prehistory will have access to different sets of fragments and will recover different aspects of their attributes. No one of these disciplines possesses a rich enough set of data to independently interpret a prehistoric culture as a whole. But since the concept of supervenience requires that each cultural component will possess properties stamped upon it by the collective emergent culture, then by studying these extrinsic properties from a combination of disciplines they should all reinforce each other and only allow an extremely limited number of combinations. The temptation within each discipline will be to stress just those aspects of recovered data that confirm their own in-house assumptions, and there will be more or less genuine naivety concerning other aspects of their own data that contradict or fail to fit their favoured within-discipline models.

Our method can build upon this set of circumstances by reconstructing the lost reality of a prehistoric culture using this property of emergence in the supervenience relation between the part and the whole in a cultural system. Following this procedure we can reverse the logic of 'emergence' theory (Johnson 2001; Sawyer 2005). Instead of seeing how complex totalities can emerge from the combination of simple elements, we assume that a complex totality once existed of which the data

fragments we now have must have been parts. These data fragments should preserve within themselves remains of an order and structure which is the trace of this now lost cultural system. Each fragment of data from each discipline will have properties that transcend its intrinsic nature, the source of which comes from supervenient emergence. We would expect the test of this claim to be the finding that once forensically inspecting these extra properties their meaning will be repeated across disciplines, each re-confirming the other. Further there will not just be repetition with disciplinary fragments, but in their differences they in turn will allow only a very limited set of combinations of meaning which will exponentially raise our interpretive power. If this procedure is sound we would expect at least three outcomes. First there will be redundancy across disciplines, in which the properties of recovered fragments of a culture from one discipline will be repeated in other disciplines. Second we would expect that the form and content of extra-intrinsic properties of a recovered fragment from one discipline can only be explained by the different extra-intrinsic properties of a recovered fragment from another discipline. In this mutual cross-disciplinary combination a new property is revealed which is the re-emergent emergent reality of the lost prehistoric culture. While in isolation each recovered fragment cannot reveal the structural level symbolic meaning of the culture, the partial properties of each allow just one type of combination which displays fully symbolic emergent characteristics representative of the structural-level processes of the monument builder's culture. Third, that once we have collected and integrated a number of recovered fragments, the consolidated theory that allowed this integration feeds conceptual inflation, in which other data previously anomalous to extant theories can now be understood as part of this re-emerged reconstruction of prehistory. While only computer simulations will be able to model the hyper large number of interactions that constitute and create a culture, from the re-emergent fragments of an ancient totality we can simulate the possible connections they allow us to discriminate amongst the available theories of the past that we have.

### **Re-emergence at Stonehenge**

Let us return to the substantive findings made at Stonehenge, but now restate them in order from intrinsic to abstracted by a Neolithic cosmology. If we consider the sun intrinsically as a body in isolation, we might describe it as a round bright disc moving across the daytime sky, which evokes categories such as light, heat, day/night, and seasonality. In the sun's relationship to some marker, such as its horizon rise or set

points, then extra categories such as east/west, summer/winter solstice or any intermediate point between them may be invoked. A *structure* which has an alignment on the sun's horizon rise or set position marks one or two points or periods in the year at the start of day or night. The materials and architecture of such a structure could be anything from just two wooden posts to the challenging architecture of binary nested circles and arcs of tiered and serried ranks of lintelled sarsen monumental pillars as at Stonehenge. Starting with direct observation of the sun we therefore build a more focussed and exclusive suite of properties when it is observed in relation to the Stonehenge architecture. Each suite of properties focuses on an ever-narrower range of attributes of the sun. A similar hierarchy of attributes can be listed for the moon. Intrinsically direct observation of the moon usually evokes the image of full moon as a bright disc moving through the night time sky. However unlike the sun the shape-shifting moon offers lunar phases in which waning moon can be seen only in the morning sky and waxing moon only in the evening sky. Horizon alignments on the moon are also possible, although now not in a solar annual timescale but in a nineteen year draconic cycle<sup>8</sup> which maps all of eight possible rise and set positions of its complete range compared to the four of the sun. And lastly if we consider the horizon properties of the sun and the moon in combination, a double alignment on the sun and the moon will select an even more precise set of attributes which emerge from the draconic cycle of their association which we have listed above. When we start with the direct observation of the sun and the moon, we draw upon the attributes of luminosity of both during the day and night. But paradoxically, by the time we get to the Stonehenge axial paired alignments on the sun and the moon, we find that the monument is designed to time a ritual at the moment when neither the sun nor the moon can be directly observed. The changing scope of attributes at each level admit only a limited range of explanations and, to take the extreme limits of this scope, an alignment on the rising summer solstice sun compared to the setting winter solstice sun completely changes the type of explanation we can offer. Discovering the suite of 'astronomical' attributes at Stonehenge, and what type of explanations they would bear, was the purpose of my 2006 paper.

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<sup>8</sup> Actually the draconic cycle of 18.61 years.



All three expectations for the method of re-emergence are met by these findings. The archaeology of the NW European Neolithic predicts an indigenous and conservative forager culture to have selectively engaged with the cattle herding Neolithic. The anthropology of the switch from bride-service forager societies to bride-price pastoral societies predicts a reversal in gender relations from matri-focal to patri-focal. The sex strike theory predicts a Palaeolithic founding cultural cosmology which is phase-locked around dark moon sacred matrilineal seclusion rituals. Together with the lunar-solar conflation for the archaeoastronomy of Stonehenge, the same principle of reversal applies to all of these disciplines and models and therefore we have redundancy with triangulation. Considered separately each of these sets of interpretations do not define the Stonehenge monument builders culture. But since we find themes of continuity and reversal common to them all, then we can look at them as separate pieces of a single jigsaw. When we combine all four of these different contributions we can therefore build a bigger picture of the Stonehenge monument builders culture which reveals a solarising dynamic of elite cattle owners and specialists confiscating ancient lunar-respecting rituals to a lunar-denying version of a dark moon ritual. Instead of direct immediate daily observation of the moon, we have the cryptic properties of a once<sup>9</sup> in nineteen year reversed phased moon which takes a year to reveal all the phases of one month. It could scarcely be possible to imagine a more point-by-point rejection of lunar properties to be smuggled into a seeming lunar-respecting monument. This meets the second expectation of re-emergence of a hidden totality<sup>10</sup>. And we have the third expectation of theoretical inflation. The main theories of Stonehenge and the Neolithic are archaeological and are unable to explain much of the data that has been recorded for both. However this emergent theory of reversal through cosmological estrangement can. Monumental architecture, drinking cups (Beakers), an axe/mace cult, lunulae (jet/gold standardised crescent shaped necklaces), gold cone hats, human (including child) sacrifice<sup>11</sup> – all of these are consistent with a Neolithic and Early Bronze Age culture which is decisively breaking with an egalitarian forager past whilst simultaneously conducting a pretence of continuity with that past. The wide extent of anomaly cancellation allowed by this re-emerged

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<sup>9</sup> See note 3.

<sup>10</sup> Speculatively, and as a guide for further research, it is ideal material for specialist priestly cult knowledge.

<sup>11</sup> All of these are distributed among the very wide scholarly literature of the European Neolithic.

reconstruction of the lost reality of the Stonehenge building culture has the inflationary effect of a paradigm shift. While inflation allows us to draw in these other large sets of findings from archaeology, they are also a spur to repeat the cycle of research with more detailed study of the properties of each in the expectation that they also will generate 'the same' or a modified re-emergence of their cultural context. Through inflation the method of re-emergence therefore generates its own tests.

While I was carrying out this research I was contacted in 2002 by the film company Parthenon Entertainment to participate in the production of a film on Stonehenge. Over the course of some months of negotiations it transpired that the company decided to focus the entire film upon my research findings. The rationale for including the film 'Stonehenge Rediscovered' (Sims 2003) in my PhD by publication can be found appended to the DVD in the production and publication part of this thesis.

### **Publication**

With method, archaeoastronomy, anthropology and archaeology all in place I was ready to offer a paper to an archaeoastronomy conference and then, after this peer review process, offer an expanded paper to a more widely circulated journal. To this purpose I presented papers at two SEAC conferences in 2005, the first in Torun in Poland and the second in Isili in Sardinia. SEAC conference proceedings were very useful for peer review and publishing early versions of my research (Sims 2006a, 2006b). In 2006 my paper on Stonehenge was accepted by the internationally respected Cambridge Archaeology Journal (Sims 2006c). Since this paper was based upon an upgraded version of two of my earlier published papers in SEAC conference proceedings, these two are not to be included in the submission for PhD by publication.

At SEAC 2006 I presented a paper studying the properties of lunar standstills in general, which this was published in 2007. Using computer astronomy programmes I generated a number of very large datasets for lunar-solar cycles from 3000 BC to the present, and demonstrated that the Stonehenge property of dark moon synchrony with winter solstices could be generalised to summer solstices, and that both are invariant of place and time. This directly contradicts the favoured choice of lunar phase preferred by most archaeoastronomers, who claim that full moon is being selected at solstice calendar festivals (Sims 2007). My paper demonstrates that full

moon never coincides with the solstice during a lunar standstill. It further suggests that ancient monuments were following a syntax of alignments mainly focussed on settings rather than risings, and in which dark moon winter solstice rituals were signalled by the southern major and minor standstills and in summer of the same years signalled by northern major and minor standstills.

### **Re-emergence with agency at Avebury**

It was not until 2008 and 2009 that I was ready to return to my 2001 critique of Tilley. During another semester sabbatical in 2007 I was able to make many visits to Avebury, and during this fieldwork evaluated how the survey techniques of archaeoastronomy could be allied to Tilley's post-processual landscape phenomenology. Our discussion of the method of re-emergence so far has not directly addressed the main criticism of system theory that it abolishes agency in its cultural models. As part of the post-processualist turn in the Humanities, landscape phenomenology rejects devising tests for abstract models posited on 'rules' or 'systems' and sees cultural meaning as being constantly created and negotiated by active agents. While originating in geography (Tuan 1977) this method has been adopted by some archaeologists (Tilley 1994, Whittle 1996, Thomas 1999) to view and walk monument remains in their landscape. The individual sensations of walking avenues like those at Stonehenge and Avebury, even today, allow us to re-experience some of what prehistoric participants may have experienced and thereby suggest plausible interpretations of the monument's purpose. Along each avenue's course the changing experience of up/down, wet/dry, left/right, and within each monument the variable sense of open/enclosed, high/low, wood/stone, white/green<sup>12</sup> and the bounding landscape properties that surround both of chalk/clay, flat/hilly, close/far horizons allow us to immerse ourselves in the 'topophilic' sensibility that the original builders intended (Tuan 1977). This conscious bodily experience mediates inner perception and the external material world and, by immersing ourselves in the monument remains today, is a resource for archaeologists to construct plausible interpretations of their meaning. This method has the advantage of looking beyond single site excavation traditionally associated with archaeology, and instead of assuming each site in isolation within an abstract Euclidean space, seeing it as one part of a monument complex in its wider local landscape. A

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<sup>12</sup> There are good reasons to suppose that within Avenues and enclosures the builders stripped the turf, revealing the chalk below.

drawback of this version of phenomenology is its nominalism, since it draws on the intrinsic properties of what is individually observed, and cannot recover the cultural level collective representations that any system of meaning may have attributed to them. The method of re-emergence can recover the collective representations of an ancient culture, but the philosophy of supervenience also requires us to accommodate individual agency within the emergence process of culture. We therefore have to additionally demonstrate that landscape phenomenology in particular is compatible with the realist ontology of emergence theory. It was in my paper on the Avebury monuments in particular that I dealt with this issue directly (Sims 2009). These monuments are just 18 miles north of the Stonehenge monument complex and were contemporary with them. While roughly comparable amounts of labour were required to build each group of monuments, they are the product of different groups of people and this is reflected in their almost diametrically opposed designs. The Avebury stone circle is not lintelled like Stonehenge and unlike Stonehenge's compact design Avebury is the largest stone circle in Europe. But by far the most startling difference is that the Avebury builders had added to their ritual landscape the largest artificial 'earth' mound in Europe, Silbury Hill, all 'linked' by two avenues against Stonehenge's one avenue. While Stonehenge's lintelled architecture and compact design very clearly creates two windows to the background sky, and this equally clearly suggests the relevance of an archaeoastronomical hypothesis, the 37 metre high truncated cone of Silbury Hill displays no design features that might be construed as an 'astronomical' alignment. However the curious landscape positions of the Avebury monuments, with Silbury Hill located in the lowest part of the local landscape and with the five major structures of the complex divided by intervening hills, all suggested that the archaeological method of landscape phenomenology could be useful. Archaeological site excavation isolates each monument in an abstract space to better precisely map the patterns of recovered material remains. Landscape phenomenology places the embodied active individual within the landscape context of the locally related monuments considered as a single complex. Instead of two dimensional plan views in site excavation reports, with this method we have reports of embodied experience in a three dimensional landscape imaginatively walking the monument remains as they once were. The active construction of meaning that comes with the concept of embodiment brings the monument builders closer to our understanding if what we

feel when we walk through them can be justified as close to their feelings. Perhaps this is how we should understand John North's observation that when approaching Stonehenge uphill along 'The Avenue', as its builders intended it to be approached, that monument's location on the side of a hill facilitated temporarily freezing the view of the setting winter solstice sun, so encouraging the masterly illusion of 'stopping time'.

Landscape phenomenology as presently practiced comes with a number of disadvantages. Few checks are integrated into the method to disentangle 'embodied experience' from 'embodied expectations'. In archaeoastronomy rigorous sampling procedures have been adopted in testing whether any findings for monument alignments were the intention of the builders or simple random accidents, so in landscape phenomenology more effort needs to be made in testing one set of monument architecture against all the other logically possible designs and routes in that local region. Second, the understanding of landscape needs to be widened to include skyscape. And third, the practice of ad hoc imputations of ethnographic meaning to landscape features, unjustifiably allied to the nominalist subjectivism of 'embodied experience', needs to be replaced with procedures for recovering the re-emerged cultural meaning of the monuments' cultural context. Our use of the property of supervenience to reconstruct a lost culture of meaning rather than our own subjective, albeit embodied, impressions, should be able to recover how our ancestors actively interpreted the monuments.

After many hours of field work in many visits amongst the Avebury monuments and landscape, I designed a test based upon the remarkable contrast between the flat open landscape north of the Avebury circle and the distributed placement of the Avebury monuments hinged around the circle in landscape to the south broken by four substantial hills. Previous research had considered Silbury Hill in isolation, variously interpreting it as a sepulchre, a display platform, a viewing platform, or an emulation of the Egyptian pyramids. While showing that none of these explanations worked, viewing Silbury Hill along the two Avebury Avenues connecting two other parts of the contemporaneous monument complex revealed previously unknown emergent properties to Silbury Hill. Comparing the thirty logically possible alternative arrangements for the same monuments in their local landscape, it emerged that the builders had chosen a design and route so as *not* to observe Silbury Hill except in five carefully chosen positions. For about 80% of their length the Avenues do not

allow any sight of the Hill, but in the remaining positions a small cropped chalk-white top can be seen either just proud of or exactly level with the background horizon. I called this re-adjustment to landscape phenomenology - 'landscape as a region of alternatives'. It provides rigorous sampling procedures applied to a virtual population of other possible Avebury monument complexes. If we find that a particular portfolio of properties are specific to the one chosen arrangement of monuments compared to all the alternative possible arrangements, then we are justified in interrogating their possible meanings. In a detailed examination of all of these monuments inter-visibly integrated by the Avenues I showed that there is just one way of combining all of the emergent attributes – the monument builders had built in Silbury Hill a facsimile of the moon in its various phases before and after dark moon. From the standpoint of landscape phenomenology and post-processualism in general, their emphasis on recovering the active agency of individuals as against its eradication in system theory, is confirmed by this supervenient example of emergence. For an individual walking the avenues, and for that individual to be steeped in the habitus of a lunar-solar cosmology, to see the two views prescribed by the avenues of Silbury Hill's flat top exactly in line with the background horizon can only admit of one active way to interpret that view. There is only one place to see the moon when it has set, and that place is the underworld. The order of views along the avenues when travelling from west to east is exactly that order of views from waning crescent, to dark to waxing crescent moon as it would be seen in the underworld. For us today to walk these monuments we must imaginatively re-embody our sensibilities to accommodate a death and resurrection ritual to be consistent with our re-emerged reconstruction of the lost reality of the Avebury monuments. Therefore the supervenient high order property of a lunar-solar cosmology is the precondition for individuals to socially construct the lower order embodied experience of an initiatory journey through the underworld. This interpretation of the Avebury monument complex was published in summary form in the SEAC conference proceedings in 2008 (Sims 2008), and in a much elaborated version by the internationally respected Journal of the Royal Anthropological Institute in 2009 (Sims 2009a).

Just as my work on Avebury was being published two challenges presented themselves which required urgent attention. In 2008 a team of archaeologists claimed that one of the two Avebury Avenues did not exist in the form Stukeley recorded in the eighteenth century (Gillings et al. 2008), and in 2009 a world leading

archaeoastronomer claimed they could not be interpreted by archaeoastronomy (Ruggles 2009). If either or both these claims were true, my interpretation of the Avebury monument complex was wrong. My writing therefore was forced to change tack to critique these two new claims. While I first experienced this challenge as a tedious diversion it has in fact been a very instructive exercise and led to the writing of five new papers.

Gillings et al. (2008) made the claim that an empty 50 metre square trench south-west of the Longstones Enclosure 'proved' that the Beckhampton Avenue at Avebury must end in this location and had not continued further to the south west to 'Fox's Covert'. My interpretation of the monument complex accepts the eye witness accounts of 18<sup>th</sup> Antiquarians and folk testimony that it did so and this provides one piece of evidence for the construction of Silbury Hill as a facsimile of the moon.

While researching the background to the antiquarian testimony on Avebury the editor of Time and Mind invited me to present a paper for publication on the subject. To this end I brought together 24 reasons why there were good grounds to believe that the Beckhampton Avenue did extend to Fox Covert, and that one short excavation trench did not meet the scholarly standards of 'proof' (Sims 2009b).

Clive Ruggles (2009) claimed coves, rare open box-like arrangements of very large stones integrated into avenues and henges in prehistory, displayed no general astronomical properties and that archaeoastronomy had failed to come up with an explanation for them. Stones in coves are probably the largest that were ever moved in prehistory. Of the three known coves at Avebury one of the stones weighs over 100 tons. However this is a disingenuous claim from Ruggles, since he is aware that John North has suggested an archaeoastronomical explanation of the cove at the northern centre of the Avebury circle. I was invited as a keynote speaker at the Sophia Centre, Bristol, cultural astronomy conference in 2009, and used the occasion to show in this paper (Sims 2010a) that North's interpretation is sound, and similar interpretations can be made for the two other coves at Avebury integrated into the two avenues, and for the four other known coves in the British Isles.

The fault line between some archaeoastronomers displayed by Ruggles' position partly reflects a split between a strictly statistical approach and one that considers individual monuments through their design details. There is no need for this split since many researchers, including Ruggles, use both according to the case they are

studying<sup>13</sup>. Nevertheless it is a frequent challenge at SEAC conferences to those like me who consider single monuments in isolation. In my view, the failure to widen the range of our methods is holding back the discipline. In my 2010 paper I challenge this position through an interpretation of the much misunderstood northern section of the West Kennet Avenue at Avebury (Sims 2010b).

At the 2009 SEAC conference in Alexandria, Egypt I presented a paper that took on the issue of an appropriate methodology for individual monuments by a detailed examination of the West Kennet Avenue at Avebury (Sims 2012a). I showed that a statistical test could be devised even from a population of one monument by simulating a virtual population of West Kennet Avenues from all of the local landscape alternatives. This testing procedure confirmed with modification an earlier study made by John North. Appendix 3 of this thesis discusses the standard statistical tests of the null hypothesis that any alignments found along the West Kennet Avenue can be explained by chance alone.

At the 2011 SEAC conference in Evora, Portugal, I presented two papers. One made a preliminary study of gender asymmetry in the Neolithic with particular reference to the West Kennet Avenue. Building upon all of my earlier papers with particular reference to West Kennet Avenue, and critiquing what were for the excavator paradoxes in the form and content of the Avenue, I show that these anomalies can be cancelled by a model of the male monopolisation of the 'gender of power'. The second paper was an invited keynote speech on the future of archaeoastronomy. Both papers have been accepted for publication in the conference proceedings (Sims 2012b and c).

## **Conclusion**

The detailed story of how the film came to be made and focussed on just my research can be found in Appendix 1. The full list of my publications and their word length can be found in Appendix 2, while the titles and publishing details are in the Reference section.

In summary in the work for this PhD by publication and production I have:

1. Developed an archaeoastronomical model of lunar-solar conflation for Neolithic/Early Bronze Age North-west European monuments.

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<sup>13</sup> See Ruggles interpretation of the 'unique' Newgrange chamber tomb (Ruggles 1999: 12-19).



2. Developed a methodology which considers prehistoric monuments, skyscape and landscape as coupled systems amenable to a multi-disciplinary interpretive method integrated by the concept of re-emergence.
3. Decoded Stonehenge.
4. Decoded the Avebury monument complex.

My research has had some impact in academic and public domains. In 2003 the film company Parthenon Entertainment produced a popular film of my research into Stonehenge commissioned by National Geographic which has been distributed to global TV networks. In 2011 I was also invited to participate as a scholar on Stonehenge in the TV series 'The secret life of buildings'. In my role as Director of percussion performance at Stonehenge and Avebury every summer solstice I am a member of the Stonehenge Round Table hosted by English Heritage and the Avebury Sacred Sites Forum hosted by the National Trust. In 2005 I joined SEAC at their conference in Rhodes, Greece and have presented papers since at every annual conference bar one up to the present. In 2008 I was elected Vice President of SEAC. Four students have enrolled as PhD students at UEL following projects prompted by my research. One of them, John McDonald, has been engaged on computer modelling Wessex prehistoric monuments in their landscape and skyscape as a test bed for all theories that aspire to understand them. My CAJ publication on Stonehenge in 2006 prompted researchers in Ohio, USA to contact me in 2007 regarding a conference and other meetings they were arranging upon the Newark prehistoric earthworks. In the spring of 2008, financed by a Fullbright scholarship, I spent two weeks on a state speaking tour for them and the Newark Earthworks committee. During the last decade I have been invited to speak on my research at conferences, university departments, extra-mural courses, schools and many other events. Throughout this time I have critiqued extant models and methods within archaeoastronomy and archaeology for interpreting the prehistoric monuments of north-west Europe. I have argued that if integrated with anthropology a new understanding can be gained of their meaning to those who built them. Within the intellectual arch of these three disciplines I see archaeoastronomy as a keystone discipline that can unlock impediments in each discipline to raise our power to understand the past.

## **Appendix 1 Rationale for including film ‘Stonehenge Rediscovered’ for PhD by publication**

The film ‘Stonehenge Rediscovered’ was commissioned by National Geographic from the film company ‘Parthenon Entertainment’. Initially the idea of the company Executive Producer, Carl Hall, was for a programme on Stonehenge that included a number of authorities on design, new age philosophy and the work of an engineer, Bruce Bedlam, who had come up with a model of Stonehenge which he claimed was a roofed building (Fig. 1). Apparently Bruce had suggested to the company to contact me to verify the strength of his theory and accuracy of his model. It is true that Bruce had earlier contacted me by email, but I had politely and very gently responded with some observations on why I did not agree with his view that Stonehenge had originally been a roofed building. It transpired that in April 2002 the company contacted me to ask for my view, and sent one of their directors to meet with me at UEL. To the great surprise of the director, I pointed out that there were many reasons why Stonehenge could not have been roofed.

Fig. 1 Bruce Bedlam and his model of a roofed Stonehenge



For example:

1. There were four main re-building episodes for Stonehenge spread over a millennium from the beginning of the fourth millennium BCE. This design relied on components which were not contemporaneous.
2. The variable height of the largest stones was incompatible to the load bearing requirements of the suggested roof.
3. The asymmetrical arrangement of the largest stones was inconsistent with the symmetrical load bearing requirements of the suggested roof.
4. The design did not take into account extranumerary stones of the monument such as the four station stones and the Heel Stone, or other design features such as the surrounding ditch, embankment and approaching Avenue.
5. A roofed structure would have changed the soil profile by leaching from rain shedding off the roof eaves, and this would have been detected by site excavation. No such soil variability had been discovered, in spite of the proclivity of many archaeologists to seek and accept any evidence of roofed structures (to fit their main theory of the Neolithic Revolution which requires sedentary agro-pastoralism).

The company representative was dismayed at this conversation, and after an exploratory discussion of what I thought the monument was all about, he departed saying that he would report back to his boss. A week later I was surprised to receive a phone call from the office of Parthenon inviting me to lunch with the Executive Producer to discuss his plans for a film on Stonehenge. Film and media companies frequently contact us as anthropology staff to give advice on various projects they have, but they rarely culminate in such an invitation. Come the lunch and I meet Carl Hall and his research assistant Ameneh Enayat. He sketches out his plans for the film as I had previously been told, mentioning his idea of having a number of contributors, including Sarah Shurety (Feng Shui consultant), Lord Richard Rogers (Millenium Dome designer) and Professor Paul Valdes (Palaeoclimatologist). For the next two hours he questions me on Stonehenge, and then invites me on to the film to take the place of Bruce Bedlam. He suggests that I work with Ameneh devising an archaeoastronomy/anthropology component of the film, to which I agree. Over the period of a few months, and by email, Ameneh questions me about many details of Stonehenge and asks for advice on how to translate them into a storyboard. She

also asks me for my publications on Stonehenge to assist her, and to send off to National Geographic for their evaluation. I later found out that they also asked Professor Barry Cunliffe, an iron-age expert at Oxford University, for his view on my theory of lunar-solar conflation for Stonehenge and many other monuments of the late Neolithic/Early Bronze Age in NW Europe. It transpired that National Geographic was favourable to my paper and gave the go-ahead to Parthenon, and that Barry Cunliffe generously told Parthenon that my theory 'would work' and was worth putting in the public domain in their film.

After all these exploratory discussions Carl decided to change the film so that it focussed solely on my research, and to dispense with his plans to have a collection of contributors looking at Stonehenge from a number of different perspectives. He then asked for my advice on editing a computer graphics sequence he had sub-contracted out to be included in the film, on the details of a new script looking at various aspects of my theory, and on a variety of locations and prehistoric sites which could be visited for the making of the film. I met with the Virtual Reality programmers to look at the early models they had constructed, and advised them of the architectural details they needed to capture. They had also made a very embarrassing mistake of tracking the setting sun and moon from right to left and this was corrected (Fig. 2).

Fig.2 Closing sequence shots of Virtual Reality model of Stonehenge showing lunar-solar conflation

- a. Winter solstice sunset in the lower gap of the Grand Trilithon as seen from the Heel Stone



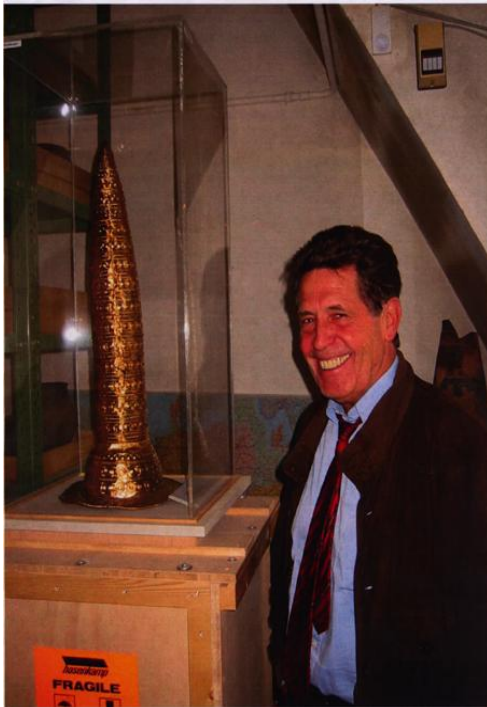
- b. Southern minor standstill moonset in the upper gap of the Grand Trilithon as seen from the Heel Stone



I worked in detail with Ameneh on the script, breaking it down into different scenes in suitable locations. As a member of the English Heritage Round Table which organises the summer solstice public access festival at Stonehenge I could also advise the company on who and how to make the approach for filming rights at the monument. I also suggested that since the University Samba Band, of which I was the Director, would be playing at Stonehenge on the night of the summer solstice at the invitation of English Heritage, they might want to put this in the film as an example of one type of contemporary engagement with the monument. They enthusiastically agreed. We also arranged the dates where I would be interviewed on camera in a variety of locations. For the prehistoric sites to be visited I did point out that one of the most spectacular monuments was Chichen Itza in Mexico, but that made them smile and they said 'nice try'. I then suggested that Avebury as well as Stonehenge, both in Wiltshire, should be in the film, and also Newgrange in Eire. This was agreed, and arrangements were made for a 2-day visit with filming and interviewing in Wiltshire and a 3-day visit to Drogheda in Eire. After these two trips Carl was advised by National Geographic that they wanted a European input into the film for distribution reasons, and he asked me to visit Germany with them to look at stone circles there. I had no interest in doing this, not least because there are no stone circles in Germany. I suggested to him that it would be a good idea to speak to a German, and recommended him Professor Wilfred Menghin of Berlin Museum. I had exchanged emails with Wilfred earlier about his research on the gold cone hats embossed with hundreds of motifs of the sun and the moon of the Early Bronze Age which had been found distributed over all of Europe (Fig. 3). This they also agreed. This completed my involvement as consultant and main participant in the film. Parthenon then edited the film for a family audience and it was distributed world-wide by National Geographic, appearing on main national TV channels all around the world. I subsequently received many emails from all around the globe. As I had a central role in the production of this film about my research, I am entering it as a

component of my PhD. Doctorate's, wholly or in part by production, are accepted by UEL and the AHRC (<http://www.avphd.ac.uk/>). As the film production took over a year in the making, I estimate it as equivalent to one major article of about 12,000 words.

Fig. 3 Professor Wilfred Menghin of Berlin Museum with one of his gold cone hats



To summarise, the rationale for including the film 'Stonehenge Rediscovered' in my PhD by publication is:

1. The entire text of the film is focussed upon my theory.
2. I acted as main consultant at every stage of its production.
3. I liaised in detail with the company researcher Ameneh Enayat at every stage of the film's conception.
4. I advised and introduced the production team to key organisations and researchers (eg. Bru na Boinne Heritage Centre, English Heritage, UEL samba band, Professor Wilfred Menghin).
5. I worked closely with the company and National Geographic over the course of one year to complete the film's production.

6. The research content of the film narrative was peer reviewed by Parthenon Entertainment, National Geographic and Professor Barry Cunliffe of Oxford University.

This rationale can be verified by:

1. Viewing the film.
2. Requesting documentary traces in my possession of this collaboration.
3. Contacting Carl Hall, Executive Producer, Parthenon Entertainment, 66-68 Bell Street, London NW1 6SP.

## Appendix 2 Research Publications Word Length

<u>Publications</u>	<u>Word length</u>
Art and Representation	1,037
Solarisation of the moon	11,604
What is a lunar standstill?	3,545
Integrating archaeology with arch.	3,431
Entering the underworld	10,776
Coves, Cosmology & Cultural Ast.	9,005
The Logic of Empirical Proof	5,733
Which way forward for archaeoast.?	6,314
Theoretical sampling	6,647
Out of Africa	5,468
Where is archaeoast. going?	3,718
<b>SUB-TOTAL</b>	<b>67,278</b>
Stonehenge Rediscovered film	12,000
<b>RUNNING TOTAL</b>	<b>79,278</b>
Critical Review	11,006
<b>GRAND TOTAL</b>	<b>90,284</b>



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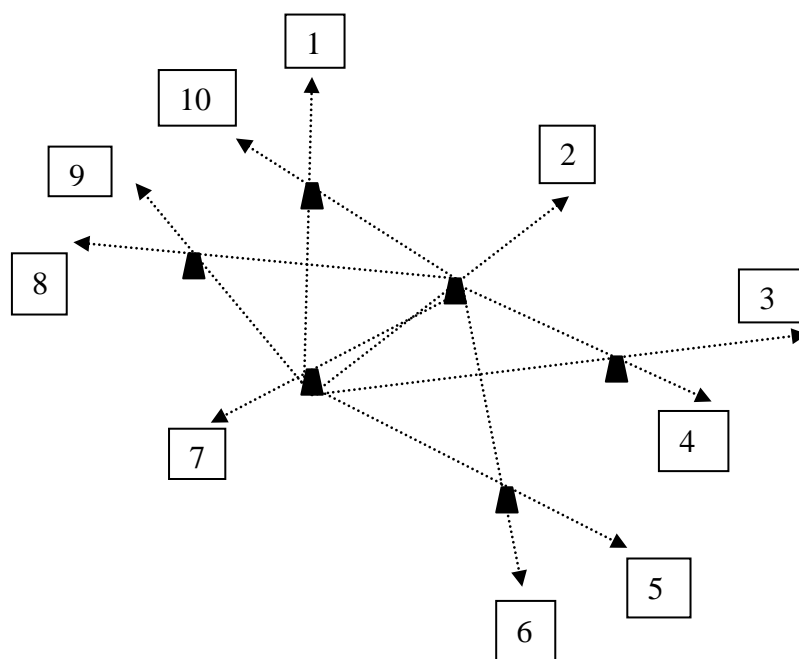
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### Appendix 3 Validity tests for the West Kennet Avenue alignments.

In three papers of this PhD I have suggested that a large number of alignments were intentionally built into the design of the late Neolithic/EBA West Kennet Avenue. As explained in the papers, the roughly parallel row of about 100 paired stones of West Kennet Avenue linked the Avebury Circle with the Sanctuary 2.4 kilometres away. The northern section of the Avenue, including most of the stones or stone holes from pair 1 to 37, was excavated by Keiller and Piggot before 1939 (Smith 1965). Where stones were recovered they were re-erected in their original stone holes. Through a critique of the exploratory work of Thom & Thom (1976), Burl (2002) and North (1996), I decided not to adopt the assumption of all three that the Avenue was composed of a series of straight sections, or North's additional assumption that it was made up from rectangular 'cells' of four stones. Instead I chose a more reductionist procedure using the stone pair as the unit of analysis which in itself precludes neither 'straight sections' nor 'cells'. However what for these three authors might be 'errors' from an assumed ideal may reveal additional properties in their own right. In Fig. 1 below I show the ten possible alignments from any pair of stones. With

Figure 1 The ten possible alignments across any pair of stones in an Avenue



this in mind I conducted extensive field work along the Avenue over many visits. This revealed previously unnoticed design properties in the Avenue layout. For example when standing at any one of the stones with an eye height of an adult Neolithic man many opposite, adjacent and diagonal stone tops are arranged to be in line with the background horizon. Bracketing Avenue design with the level of the background horizon suggests that some horizon event might be included in the ritual meaning of the Avenue. Further properties, such as cruciform cardinal in-line stone section breaks and changing stone shapes, occur along the Avenue at places that coincide with a possible lunar-solar logic. The reader can refer to the three papers for a full account of these properties.

North pointed out that caution is needed for the archaeoastronomy of the Avenue since few stones break the horizon and it is difficult to identify a precise horizon point estimate (North 1996). The stones are large and close together, each pair of opposite, adjacent or diagonal stones being about 14m, 23m and 27m apart respectively (Sims Field Notes). The angles subtended by a 2m wide stone over these short distances are large – about 10° or 5° when viewing from opposite or diagonal stones respectively. Rather than assuming that this monument was designed for precision alignments, I worked from the hypothesis that the builders intended to create the illusion of the sun and the moon rising from and entering into many of the stone tops when viewed from alongside and *outside* of the Avenue. As Richards (2004) suggested that half buried sarsen stones within the Avenue would have impeded large processions, and Pollard & Reynolds (2002) document compressed Neolithic soil profiles outside and alongside the Avenue, there is archaeology which lends support to this hypothesis. Such an artifice suggested the builders worked with a range of 5° to bring a horizon solstice or standstill rise or set within the top of a stone. 145 lunar, solar and cardinal alignments were found with this property along this section of the Avenue. These alignments are shown in Table 1 below.

Adopting these large ranges for establishing an alignment is an ‘ethnographic’ (Ruggles 1999) or ‘religionist’ (North 1996) hypothesis that breaks with the high fidelity assumptions of eclipse predicting ‘astronomer priests’ (Thom 1971). And for modern archaeoastronomy that has yet to embrace ethnographic modelling these ranges exceed standard practice. To accept a range of 5° for the four solstice, eight

Table 1 Alignments of West Kennet Avenue stone pairs 1-37 with adjacent and opposite stones.

Comb: Pair	1	2	3	4	5	6	7	8	9	10
1			SMinR					NMajS		
2								NMinS		
3				SMajR						NMajS
4		NMinR	South				SMinS		NMajS	NMajS
5			SMajR					North		
6	North	NMajR	East					NMajS		North
7		SSR		WSR				West	NMinS	NMinS
8		NMajR	East	SMinR	SMinR		SMajS		SSS	SSS
9		NMajR	East	SMinR	SMinR			West	NMinS	SSS
10			East		SMinR		SMajS		SSS	SSS
11			East		WSR				SSS	SSS
12		NMajR	East	SMinR	SMinR			West	SSS	SSS
13				WSR	WSR		SMajS	West	NMinS	NMinS
14		SSR		WSR			SMajS	West		NMinS
15		NMajR	East		SMinR	SMajR	WSS	West	NMinS	NMinS
16		SSR				South	WSS	West		
17	North		SMinR	SMajR	SMajR				NMinS	
18	North		SMinR			South			NMajS	NMajS
19	North	NMinR				South		NMinS	NMajS	
20	North	NMinR	SMinR			South	SMinS	NMinS	NMajS	
21	North			SMajR		South			NMajS	
22	North		SMinR					NMinS	NMajS	NMajS
23	North	NMinR	SMinR			South			NMajS	
24	North	NMinR	SMinR					NMinS		
25			SMinR							
26			SMinR							
27			SMinR					NMinS		
28	North	NMinR	SMinR							
29	North	NMinR	WSR			South				
30	North		SMinR							
31			WSR							
32				SMajR		South				
33	North		SMinR			South				
34	North		SMinR			South		West		
35		NMinR				South				
36	North			SMajR						
37	North	NMinR								NMajS

### Note

For any pair of stones with adjacent pairs on either side, the ten possible combinations of pairings from the central pair to all six stones are shown in Fig. 2. These combinations are numbered clockwise 1-10 as azimuths from North starting at the northern diagonal and are the column headings in this table. The row headings identify the number of the stone pair positions 1-37. The azimuth bearings for zero horizon altitude at this latitude of 51° 25' for lunar standstills, the sun's solstices and cardinal alignments (not to be confused with equinoxes) are: North 0°/360°; Northern Major standstill moonrise (NMajR) 40.5°; Summer Solstice sunrise (SSR) 48°; Northern Minor standstill moonrise (NMinR) 59°; East 90°; Southern Minor standstill moonrise (SMinR) 121°; Winter Solstice sunrise (WSR) 129°; Southern Major standstill moonrise (SMajR) 141.5°; South 180°; Southern Major standstill moonset (SMajS) 218.5°; Winter Solstice sunset (WSS) 231°; Southern Minor standstill moonset (SMinS) 239°; West 270°; Northern Minor standstill moonset (NMinS) 301°; Summer Solstice sunset (SSS) 312°; Northern Major Standstill moonset (NMajS) 320.5°

standstill and four cardinal alignments allows 80°, or just over 22%, of the encircling horizon to be accepted as a target. To find any one alignment which could be generated by chance over 1 in five times would not pass the normally acceptable validity criteria. Therefore we need to establish whether 145 alignments would be accepted as beyond the bounds of chance.

Ruggles gives two statistical tests for finding the probability of a group of alignments occurring by chance alone. The probability of  $n$  orientations falling within  $\emptyset$  degrees by chance is given by  $n(\emptyset/360)^{n-1}$ , which in this case is 1.25535E-92 (Ruggles 1999, 95). An exponent with 91 zeros behind the decimal point that precedes the number 125535 is an improbably small chance occurrence. However it could be argued that this is a spurious level of confidence, since it does not consider what may be the accidental occurrence and replication of alignments as a consequence of the Avenue being surrounded by regular horizons. It could be that a straight Avenue with a regular horizon, simply through its direction, generates across its stones large number of alignments entirely by accident. An example would be the regular high ridge of Waden Hill running roughly parallel and alongside the Avenue. We test this null hypothesis with Bernoulli's law:

$$P = 1 - \sum_{s=0}^{r-1} n!/s!(n-s)! \times p^s(1-p)^{n-s}$$

where  $r$  is the number of target alignments found,  $n$  is the total number possible alignment combinations,  $p$  is the proportion of the horizon occupied by relevant astronomical alignments and  $s$  is the series of repeating calculations running from 0 to  $r-1$  that must be summed (Hawkins & White 1966, 136; Ruggles 1999, 42-3). Since Table 1 only gives the astronomical alignments found, rather than the raw data, we need to look at *all* 370 possible pairings along the West Kennet Avenue to test where this might occur. The values necessary for these considerations are given below in Table 2.

The West Kennet Avenue is not straight. Thom found six straight sections to the Avenue between stone pair positions 6 and 37, each separated from each other by changes in direction. These sections are identified in Table 2 by line breaks. For the moment let us accept this claim and look for alignments within a single straight section that have a constant horizon. It is here perhaps that all the alignments are

Table 2 Azimuth, Altitude and Alignments across stone pairs 1-37 of the West Kennet Avenue.

Combination																					
Stone #	Azimuth	Altitude	Alig Code	Azimuth	Altitude	Alig Code	Azimuth	Altitude	Alig Code	Azimuth	Altitude	Alig Code	Azimuth	Altitude	Alig Code	Azimuth	Altitude	Alig Code	Azimuth	Altitude	Alig Code
1	12	0.7		72	0		119	0	6	148	0		150	0		195.5	0		320	0	16
2	15	0.6		68	0		114.5	0		149	0		150	0		190	0		297.5	0	14
3	10	0.5		66	0		106	0		142	0	8	147	0		186.5	0		294	0	
4	6.5	0.5		62	0	4	176	0	9	194	0		193	0		206.5	0	12	286	0	16
5	15	2		81	1		142	2	8	164	3		165.5	3.5		185	2		274	0.5	
6	2	1	1	36	1.5	2	86	2	5	114.5	2		118.5	2.5		157.5	2		223	1	
7	340	0		49	1.5	3	101	1.5		134.5	1.5	7	130.5	2		165.5	2.5		230	1	
8	342	0		37	1	2	94	1.5	5	126.5	1.5	6	126	1.5	6	157	2		220	0	10
9	338	0		33.5	1	2	92	1	5	121.5	1.5	6	128.5	1.5	6	155	2		209.5	1	
10	341	0		28.5	1		85	1	5	129.5	1		124	1	6	159	1.5	10	211	2	
11	338	0		31	1.5		95	1	5	116.5	1		128	0.5	7	157	1.5		221.5	2.5	
12	341	0		33	1.5	2	92	1	5	119.5	0.7	6	119	1	6	156.5	1		222	2.5	
13	337	0		32	1.5		100	1.2		132	0.4	7	132	0	7	162	1	10	212	3.1	
14	342	0		44	1.5	3	102	1		132	0.5	7	131	0.5		159	0.5		214	4	10
15	332	0		35	2	2	92	0.5	5	111	0.5		120	0.5	6	146	0.5	8	220	5.5	11
16	330	0.5		46	1.5	3	112	0.5		150	0.5		150	0.5		181	0.5	9	226	4	11
17	2	0	1	62	1.5		119	1.5	6	139	0	8	138	0.5	8	171	2		239	4	
18	356	0	1	62	4		120	1	6	152	0		158	1.5		182	0	9	239	4	
19	1.5	0	1	52	1.5	4	117	1.5		150	0		152	0.5		178	0	9	236	4.5	
20	359	0	1	50	2	4	119	1	6	154.5	0		152	0		183	0	9	230	4	12
21	2	0	1	62	1.5		129	0.5		146	0	8	155	1.5		180	0	9	238	5	
22	358	0	1	64	1.5		124	1	6	154	1		159	1		187	0		241	5	
23	5	0	1	59	1.5	4	122	1	6	160	1.5		155	1.5		185	0	9	239	5	
24	5	0	1	57	1.5	4	122	1	6	158	1.5		156	1.5		189	0		237	5	
25	9	0		62	1.5		127	0.5	6	162	1		157	1		190	0		249	6	
26	11	0		68	1.8		127	1	6	155	1		159	1.5		190	0		250	6	
27	9	0		64	2		127	2	6	158	1.5		159	2.5		190	0		244	6.5	
28	7	0		60	1.5	4	128	2	6	156	1.5		156	1.5		189	0		241	7	
29	5	0	1	60	1.5	4	129	1.5	7	152	1.5		159	1.5		182	0	9	241	7	
30	3	0	1	66	1.5		124	1.5	6	161	1		155	1.5		192	0		245	7	
31	9	0		71	1.5		132	1.5	7	156	1		162	1		192	0		250	7	
32	7.5	0		65	2		112	2		144	1	8	156	1.5		183	0	9	245	7.5	
33	3.9	0	1	65	1.5		123	2	6	152	1.5		152	1		183	0	9	246	7.5	
34	2	0	1	62	1.5		122	2	6	153	1.5		152	1.5		184	0	9	243	7	
35	361	0	1	60	2	4	118	2.5		152	1.5		152	1.5		182	0	9	246	7	
36	3.5	0	1	64.5	1.5		114	2.5		150	2	8	152	1		186	0		242	7	
37	359	0	1	59.25	2	4													242	7	
Notes																					
See notes to Table 1 for row and column codes.																					
Azimuth: field recorded azimuth adjusted for magnetic variation.																					
Altitude: horizon altitude for relevant alignment.																					
Alig Code: code number for alignments within 5 degrees of azimuth adjusted for zero altitude at Avebury latitude: 1 North; 2 NMajMR; 3 SSR; 4 NMinMR; 5 East; 6 SMinMR; 7 WSR; 8 SMajMR; 9 South; 10 SMajMS; 11 WSS; 12 SMinMS; 13 West; 14 NMinMS; 15 SSS; 16 NMajMS.																					
Line breaks between stone pairs 5 and 6, 14 and 15, 17 and 18, 22 and 23, 27 and 28, 32 and 33 indicate Thom's straight section breaks.																					



not independent of each other and are an accident of placing the Avenue of stone pillars on a straight route with a constant horizon. From Table 2 a possible example are the five alignments of combination 1, all on north, with a constant horizon altitude of zero between stone pair positions 22 to 18. The five stone pair positions within this section allow a total of 50 possible alignments within which were found 26 actual targets for a proportion of 0.22 of the horizon. Applying Bernoulli's law gives the probability of this being a chance occurrence of  $3.3111\text{E-}06$ , or just over 3.3 in every million times. Another application of this test is to consider the north alignments alone for this section. In this case just 0.0139 of the horizon will be covered by the  $5^\circ$  boundary within which we accept an alignment on north. For the five targets on north found within the five possible pairings gives the probability of this occurring by chance of  $5.1889\text{E-}10$ , an even more unlikely event. So by both tests for this section the constant horizon to the north cannot explain the high number of alignments on either north or the remaining 21 alignments found across all 50 possible stone combinations.

The West Kennet Avenue is not level. It follows the undulating eastern flank of Waden Hill and so arranges the stones for pair 15 to be at the summit of one anticline and for position 30b to be at the centre of a syncline. As argued in my published papers this couples local geomorphology with monument design and archaeoastronomy and allows emergent properties of meaning. Nor is there a constant altitude to the ridge of Waden Hill when viewed from the Avenue. The interaction of Avenue level, Waden Hill horizon and Avenue route creates regular changes in azimuth and altitude across the Avenue stones. From stone pair positions 37-15, looking west along combination 7, the high Waden Hill horizon runs alongside and roughly parallel to the course of this part of the West Kennet Avenue. While for the three sections from stone pair positions 23 to 37 the horizon altitude for all three ranges from  $5^\circ$  to  $7.5^\circ$ , within each section they have an *almost* level straight western horizon. This is similar to the horizon to the east, along stone pair combination 2, although now the horizon is in the range  $1.5^\circ$  to  $2^\circ$ . This allows a 'gearing' of reverse horizons across the Avenue of about a  $5^\circ$  difference in altitude. Since a single degree of altitude reduces the azimuth of a rise or set horizon position by about two degrees, and since at this latitude there is a roughly ten degrees of azimuth difference between adjacent solar and lunar alignments, a  $5^\circ$  difference in reversed stone combinations altitude generates a  $10^\circ$  change in azimuth, and will therefore allow a solstice setting to the west to be combined, Janus-like, with a rising standstill alignment to the east. It would be possible therefore to arrange the transverse paired stones to pick out an Avenue of full moons

rising out of the tops of the 'a' row of stones on east side of the Avenue. However while six alignments to the northern minor standstill moonrises can be seen between stone positions 23 and 37 there are no reverse alignments to winter solstice sunset. It is a very interesting finding of this fieldwork that the builders did not choose this option except at one point along the Avenue – at stone pair position 15. Yet here the altitude gearing is not the optimum  $5^\circ$  but instead is  $3.5^\circ$ . Since I have shown that Avenue position 30b is a dark moon position, then this predicts that pair position 15 should be a full moon position (Sims 2013). This is confirmed by the finding that at only this point along the Avenue a winter solstice sunset alignment is paired in the opposite direction with a northern major moonrise alignment to generate a northern major standstill full moon. This explains what Thom, Burl and North all considered a 'clumsy' alteration in direction at this part of the Avenue. Instead of being 'clumsy' it is a change in the alignment of stone pairs from those adjacent to it to accommodate the design requirements of a lunar-solar logic. Therefore while the local high regular ridge of Waden Hill could have by accident or intention generated a lunar-solar coupling of full moon alignments none of the three 'straight' sections from 23-37 in fact do this. While those sceptical of archaeoastronomy might hesitate to accept that this section of the West Kennet Avenue exhibits 145 'astronomical' alignments, for those who accept the validity of statistical testing in archaeoastronomy it is a paradox not that it has so many but so few alignments on full moon. It is the argument of my papers that the paradox can only be resolved by a ritual that hinged around dark, not full, moon symbolism.

There may be grounds for suspecting accidental reverse alignments elsewhere in the West Kennet Avenue. A similar error has frequently been made at Stonehenge when assuming a 'solstice corridor' along the monument's axis<sup>1</sup>. For the West Kennet Avenue this may be the case for the west and east alignments between stones 16 and 7 and the north and south alignments between 16 and 37. When walking south past the full moon stone pair positions 15 and 16 we can see in Table 2 that with just one exception only risings can be observed across the stones towards the Sanctuary. If this was a prescription not to walk on the left hand side of the Avenue observing settings, then the eleven alignments on south may just be an unintended consequence of the 15 north alignments when walking on the left hand side of this same section away from the Sanctuary. A similar possible prescription is not indicated for section 16-7, where seven alignments on west are included within alignments on both risings and settings. Nevertheless we should consider that the seven alignments on east may be an unintended

consequence of the west alignments. If we remove the 18 south and east cardinals and reduce the proportion of the horizon to 70°, the probability of 127 chance alignments is still a vanishingly small likelihood of 3.10486E-88. Therefore if we are over-generous in claiming 145 alignments, and the more correct figure was 127, then this too cannot be explained by chance.

The statistical method allows us to test the null hypothesis that any astronomical alignments we may find could be explained by chance alone. By this method we can reject the null hypothesis for the West Kennet Avenue and this frees us up to test ethnographic hypotheses. Interpretation is achieved through componential analysis of the ethnographic details (Spradley 1979). This in turn requires further tests which re-state the null hypothesis but now within the qualitative, rather than quantitative, detail of the monument design and landscape context. These categorical details, unlike the statistical method, are the architectural and landscape elements that when combined with archaeoastronomy can reveal emergent ethnographic meaning. It is therefore possible to re-state the null hypothesis through these details. If it were the case that alignments within any section were accidental, then for those sections that were straight and level with level horizons we would predict the accidental generation of the *same* alignments. It would not predict under these constraints a medley of different alignments. Second, the null hypothesis would predict that for any change in direction, level or horizon altitude a gradual drift out of alignment would occur and perhaps the emergence of a slow approximation to a new alignment. It would not predict a continuing entrainment on the same alignment that transcends these changes in constraints. Both refutations of the null hypothesis would be achieved by either qualitative change or a constant entrainment upon alignments under changing conditions rather than quantitative drift.

We can look at the issue from the point of view of Thom's claim that the Avenue is composed of six straight sections between stones 6 and 37. If they are straight, and if the altitude remains constant, then any group of same alignments may be random, are not independent, and may count as just one alignment. Directional changes along the length of the Avenue are indicated in Table 2 by combinations 4 & 5 when travelling south and 9 & 10 when travelling north. By selecting the total range in degrees of azimuth within Thom's straight sections, it can be seen in Table 3 that there are significant alterations in these combinations' directions in all bar one section. Small changes in individual stone placement with closely placed stones, which might be seen as an 'error' in a model of an Avenue of straight sections or rectangular cells, can facilitate large alignment changes

within them that cannot be explained by random changes in horizon altitude. This explains how lunar and solar alignments can be combined along the same line of Avenue direction in sections 6-14 and 15-17 when travelling both south and north.

Table 3      Azimuth range of West Kennet Avenue direction within Thom's sections

Combination

Section	4	5	9	10
6-14	20	13.5	37.5	63
15-17	39	30	23	37
18-22	8.5	7	6	18
23-27	7	4	8	5
28-32	17	6	4	8
33-37	3	0	7	6

In the West Kennet Avenue we can find an Avenue section in which the horizon altitude remains constant while the alignments change. For section 6-14 for stone combinations 2, 4, 9 and 10 while their horizons remain the same they all combine different alignments which bracket in the same direction a solstice and a standstill alignment. Rather than being a reverse pairing as in stone combinations 2 and 7 considered above, these are identity pairings. When the sun and moon are on the same stone combination, then of course the moon is dark. Further, this property not only refutes the null hypothesis by generating very similar odds to those considered above, but demonstrates that small changes made to stone positions within a 'straight' section of the Avenue can combine different alignments while the horizon is constant. We can also find the reverse case of a section of the Avenue within which there is a substantial change in horizon altitude along the same stone combination, but in which the alignment across them remains constant. For section 6-14 along stone combination 7 there is a substantial change in horizon altitude from 0° to 4°. Nevertheless although such a change in altitude horizon will create an 8° shortening of azimuth, over this full change in altitude there is a constant alignment on the southern major moonset. Both cases demonstrate intentional rather than chance alignments.

In conclusion we have found by two statistical measures that chance alone cannot explain the 145 (or 127) 'astronomical' alignments found along section 1-37 of the West Kennet Avenue. By qualitative measure we have seen that Thom's straight sections are not straight, and that small alterations in individual stone positions within a 'straight' section

allow combining different alignments within the same section. We have also found that the present consensus that the Avenue builders lacked planning foresight and had to resort to 'awkward' turns to correct route errors are not awkward at all. On the contrary there is a phenomenological coupling of stone top skyline with landscape forms to enshrine a lunar-solar logic within the Avenue's design. And while North's exploratory research on the West Kennet Avenue was the first to call attention to its integration of landscape and skyline, he's rectangular cells are not rectangular. Instead we have found that by using the stone pair as the unit of analysis rather than straight section or rectangular cell ideal, small departures in stone position in combination with changes in Avenue level and horizon altitude allow a far more subtle and ethnographically rich suite of previously unnoticed properties.

### Acknowledgments

With thanks to César González-García for asking the questions that needed this answer.

### Notes

1. For the latest refutation see Abbot & Anderson-Whymark 2012. For the definitive refutation see North 1996.

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**Sims, L.D. (2001) "Art and Representation", *Journal of Royal Anthropological Institute*, 7:1, 154-5.**

## **Art and representation on Bodmin Moor: a response to Tilley, Hamilton and Bender.**

Installation art has been claimed as a means of “re-presenting” megalithic monuments such as Leskernick Hill in Cornwall (Tilley et al. 2000). Cling film, paint and coloured fabrics are used by Tilley and his colleagues as mimetic, marking and mapping devices to uncover multiple properties of stones not discernible within the frame of photograph, book or computer screen. "We cannot recreate the meanings that the stones had to the Bronze Age inhabitants of the site", write Tilley and his colleagues (2000: 43-45). "Our work is our creative response to their creativity or, better, the ruins of their creativity". The authors continue: "For example, by wrapping cling-film on a stone and subsequently painting it, we are creating something new: a synthesis of the stone shape that we have not created and something which we have added to it...." They explain (2000: 49): "The process of wrapping served to energize the stones with our ideas and thoughts". The authors present their novel approach as an attempt "to forge a middle way between the personal, idiosyncratic approach to landscape characteristic of environmental artists and the disengaged and disinterested objectivity of visual representation in contemporary archaeology" (2000: 60).

I fail to see how this procedure advances megalithic archaeology. The authors may find it "engaging" to cover selected stones with coloured materials and reshape their archaeological spoil heaps during summer field work. They may even believe that in doing so, they are echoing the ritual performances of the Bronze Age megalith builders. But on what grounds should the rest of us take it that such antics inform us in any way about the past?

Tilley et al. chose to erect doorframes on Bodmin Moor, and through these, to record horizon lines (2000: 55). They also remodelled their spoil heaps "so that they mimicked the shapes of the distant tors...." (2000: 46). Whatever the temptations to mimic the contemporary landscape in this way, the Bronze Age inhabitants of Leskernick surely did no such thing. Unlike hunters and gatherers, pastoralist-agriculturalists in the late Neolithic were distinctive in labouring to create an artificial landscape of stone rows, circles and cairns in counterpoint with the locality which they had deforested, and with special reference to the local horizon (North 1997:358-9). Nothing suggests a concern with mere replication of natural horizons.

Tilley et al. (2000: 49) single out certain particularly large or prominent stones for artistic “re-presentation”. By covering individual stones in coloured shrouds and by



mapping selected zones with colour-coded flags, they "attempt to evoke a ritualized world of stone that linked the Bronze Age people to the ancestral past in world replete with myth and memory, nurtured through ritual and ceremony" (2000: 52). Is it likely that such invented theatricals have any bearing on what the Bronze Age inhabitants of Bodmin Moor may have been doing with these stones? I am skeptical. Tilley et al. acknowledge that they are responding to and artistically embellishing only the ruins of Bronze Age creativity. No-one would wish to deny that this can result in dramatic and startling alterations to the contemporary Cornish landscape. But what of the intentions of the Neolithic inhabitants themselves? If such matters are no longer thought to be of interest, in what sense are Tilley and his colleagues to be considered archaeologists? The past does matter, and in this context, a more persuasive and authoritative approach has surely been that of Southampton University archaeologists in their meticulous photographic recording of the stones at Avebury, and subsequent computer simulation of their original placement in a Bronze Age landscape (Southampton 2000).

The use by Tilley et al. of split-image photomontage to juxtapose the multiple properties of the stones as they mutate under changing weather and light conditions may well yield results reminiscent of a cubist painting (2000: 58). But where does this get us? The findings reported in this article appear to be completely arbitrary. For example, why does these authors' landscape apparently exclude the sky? And why is it always the daytime landscape which is chosen? Surely even installation art can stretch to the night-time sky? But then, why look to contemporary abstract art in the first place for theoretical assistance when we have the recent findings of a now matured archaeo-astronomy? Clive Ruggles (1999) and John North (1997) have persuasively argued that the Bronze Age megalith builders were manipulating their landscapes for the time-factored, ceremonial horizon viewing of stellar, lunar and solar cycles. These early farmers moved tons of stone and earth in order to create artificial horizons for such purposes. They accurately marked cosmologically significant points on these horizons using wooden and stone gauges, employing standard units of measurement and relying on a sophisticated knowledge of proportions in right-angled triangular geometry.

Tilley and his colleagues have recommended "environmental art" as a contemporary practice which can sensitise us to the possible ritual functions of megalithic monuments. I would suggest performance art as a much more appropriate candidate. At least this artistic medium puts centre stage collective rather than individual representations, and may usefully explore a variety of possible contemporary ceremonial

functions for the stones. In this spirit, Anthropology staff and students from the University of East London participated in a collective performance within Stonehenge to greet the summer solstice sunrise in the year 2000. Stonehenge has long been a contested site (Bender 1998), and on this enjoyable occasion torch-bearers escorted our contingent of samba drummers and dancers to "reclaim the stones". Whether performances of this kind can tell us anything about the original intentions of the Bronze Age inhabitants of Salisbury Plain is doubtful. But archaeology aside, I suspect our ancestors might have found marginally more relevance in this invented collective ritual of resistance than in the obscure, individualistic and idiosyncratic cling-film-and-paint offerings of Tilley and his colleagues.

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## **The ‘solarization’ of the moon: manipulated knowledge at Stonehenge<sup>14</sup>**

By Lionel Sims<sup>15</sup>

### **Abstract**

Recent archaeological research now views the North West European Neolithic and early Bronze Age as a protracted period of separation from a resilient complex of traditions of Mesolithic and even Palaeolithic origin. Extending this insight to recent findings in archaeoastronomy, this paper treats the sarsen monument at Stonehenge as one among a number of monuments with similar cosmological alignments. If the argument is accepted, ritual practices at Stonehenge privileged night over day, winter over summer, dark moon over full. The aim of the monument’s builders was to juxtapose, replicate and reverse certain key horizon properties of the sun and the moon, apparently with the intention of investing the sun with the moon’s former religious significance. This model is consistent with both current archaeological interpretations of burial practices associated with the monument, and with recent anthropological modelling of hunter-gatherer cultural origins.

### **Archaeological Models of the Neolithic**

Until the 1980’s the main archaeological model of European prehistory contrasted an itinerant, materially and culturally limited Mesolithic forager lifestyle with the fixed settlements of socially complex Neolithic farmers (Case 1969; Childe 1940; Runciman

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2001). This approach saw social complexity and the building of monuments like Stonehenge as by-products of farming surpluses. This interpretation is no longer accepted. It is now argued that from the fifth to approximately the middle of the second millennium bc the moving frontier of farming stopped in central and Eastern Europe, and so could not have been a pre-condition to North West European monumental architecture. The hunter-gatherers dwelling on the Atlantic fringes of this frontier were not replaced by farmers, nor did they immediately switch to sedentary intensive farming (M.Edmonds 1993; Rowley-Conwy 1984; Thomas 1999; Whittle 1996; Zvelebil 1986). Instead, according to current consensus, these complex hunter-gatherers switched to pastoralism, albeit variably combined with the old hunting ways and new crop-growing practices. The new material culture included the polished stone axe, pottery and monuments, which for many researchers are key signifiers of the Neolithic, all of which co-existed alongside that core indicator of the Mesolithic - a relatively mobile lifestyle which still included hunting. Rather than the point in prehistory when monument construction begins, the adoption of sedentary agro-pastoral farming in the middle Bronze Age is seen as coinciding with the *ending* of that tradition. The earlier view of prehistory assumed an under-specified, ecological, model of pre-historic hunter-gatherer cultures if only because it was necessary to the assumption of an institutionally-formative farming Neolithic (Renfrew 2001; Runciman 2001). However, '[i]t is now generally accepted that Mesolithic communities were no sense [sic] less complex than those in the Neolithic.' (Tilley 1994, 86)(See also Gamble 1986; Hayden 1990; Ruggles 1999)

The new model sees the adoption of farming as long-delayed by a contest with a pre-existing belief system.

The beliefs and values of the Neolithic period are grounded in those of the Mesolithic period...The Neolithic phenomenon was not so much the creation of new worlds as the prolongation of old ones. But there were fundamental differences between different conceptual orders...Many early foragers may have seen themselves as part of an undivided, timeless world, shared by people and the animals which inhabited it...In...the Neolithic way of life...there was categorisation and separation...Now there was a new emphasis on ...relationships with an otherworld. Speculatively, this shift may have been reinforced by guilt to do with the breaking of earlier bonds with nature.(Whittle 1996, 360).

If we link Whittle's comments more precisely with Neolithic and early Bronze Age monuments, this suggests that they can be conceptualised as devices to prolong, recapture or manufacture a sense of unity and respect for more ancient beliefs, but in ways more amenable to a Neolithic when division and estrangement are on the increase. This double purpose is seen reflected in mortuary complex and monument design. Mesolithic burials had emphasised rebirth, regeneration and fertility, with women's burials in particular associated with natural materials and animals, like antler horns. In the early Neolithic burials become housed in mounds that mimicked the mid-European long houses of the first farmers. Accessible chambers and the re-circulation of the partial remains of the dead now emphasised the theme of an ancestral collectivism which seemed largely unnecessary in the Mesolithic. Domesticated cattle skulls and hides accompanied or even displaced the dead in abstract representations of religious power (Bradley 1998; Hodder 1990; Thomas 1999; Whittle 1996). The same themes of juxtaposition, mimicry and estrangement of old and new symbolic motifs are repeated in later Neolithic and early Bronze Age monument design. Circular monuments celebrated the disc-like shape of the cosmos, designed to mimic the topography of local horizons and the movement of the sun and the moon upon them (Bradley 1998). By aligning these monuments on the local encircling landscape and the rise and set positions of the sun and the moon, the builders locked their monuments to their local place. Each regional group, focussed around their



monuments, commanded their own 'centre of the universe'. Instead of a generalised communion with the entire natural world as sacred as in the Mesolithic, Neolithic conceptions emphasised local space as a cosmological centre, reversing earlier beliefs.

[T]he experience of watching the sunset...depended upon the momentary coincidence of chalk from the earth, the descending sun, the dead in their barrow and the surrounding forest. This does not indicate any scientific observation of the heavens, so much as a perceived unity of earth and sky, life and death, past and present, all being referenced to bring more and more emphasis on to particular spaces and places...At the same time it would also limit access to these spaces in terms of both direction and timing, and would contribute to the way in which the space was experienced by promoting the impression that it stood at an axial point of an integrated cosmos. (Thomas 1999, 53)

Other authors make further contrasts between Mesolithic and Neolithic cultures<sup>16</sup>. But the general consensus amongst specialists is that monument building was central to changing and sustaining the *social* relationships which came to define the Neolithic (Thomas 1999). Following Hodder (1990), Bradley makes a strong *prospective* argument for monument construction as the necessary precondition for 'domestication':

[U]ntil local hunter gatherers had modified their own views of the world – views which may have remained much the same since the Upper Palaeolithic period – it is hard to see how they could envisage the radical changes of attitude that would accompany the adoption of farming. (Bradley 1998, 34)

This change in world view is seen as an achievement of the Neolithic as an historical armature in which monument design operates simultaneously on two levels – the commemoration of a past lived communalism through *imagined* collectives of ancestors. By the time of the Neolithic there 'is a strong sense of seasonal time, fixity of place, a celebration of the local, and an abstract collectivised sense of an ancestral past.' (Whittle

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<sup>16</sup> For example both Whittle (1996) and Tilley (1996) mention human sacrifice and (red) amber.

1996, 261) Symbolic and abstract representations of collectivism and community may well have been shadows of earlier lived forms of solidarity.

This kind of interpretation could be taken much further, to link such [monumental] sites not only with cult or ritual but with the consecration of place, the marking of time, the presence of ancestors and the *symbolic* representation of communal cohesion. (Whittle 1996, 190) (my emphasis)

Nevertheless, from these accounts it remains a puzzle as to what *retrospective* practices provided the conservative impediment that slowed the migration of farming for two or three millennia in exactly those areas in which monument construction flourished. A possible answer to this question comes from recent anthropological modelling into hunter-gatherer cultural origins.

## Anthropological Models of the Palaeolithic

It is now accepted that our species evolved in Africa between 200 and 150 thousand years ago, dispersing across the world from about 70 thousand years ago (Oppenheimer 2003; Stringer 1996; White 2003). There is a growing body of archaeological evidence that human symbolic culture had already been laid before our ancestors came out of Africa (D'Errico 2001; Henshilwood 2001; Hovers 2003; McBrearty 2000; Watts 1999). A recent return to evolutionary thinking within anthropology has assessed the evolutionary costs and benefits of various types of middle-late Pleistocene human coalitions, some of which may have encouraged the levels of solidarity now thought essential for first establishing the symbolic domain (Boehm 2001; Dunbar 1999). One result is the prediction that matrilineal coalitions in particular would have accrued substantial evolutionary benefits by phase-locking their economic and ritual routines to the rhythms of the moon (Knight 1991;

Knight 1995; Power 1999; Power 1997a). More specifically, this 'sex-strike' model predicts that the seclusion of sisters and mothers would have been optimally timed to coincide with dark moon, would have marked the time of maximum ritual potency and sacred observance, and would have triggered monthly bride-service collective big game hunts (Knight 1991; Watts 2005). This model is consistent with many cultural universals discovered by anthropology – for example the early cultural use of red-ochre (Watts 1999), lunar timekeeping (Marshak 1972), the incompatibility between solar symbolism and menstrual blood (Frazer 1971), and the incompatibility between cooking and lunar eclipses (Knight 1991). Subsequent testing of this model has also shown it to be useful in interpreting extant low-latitude hunter-gatherer practice, ritual and beliefs (Watts 1999; Watts 2005). If this model is robust, we would also expect it to generate testable hypotheses for Mesolithic forager and Neolithic pastoralist cultures. By the start of the Mesolithic ten thousand years ago European mega-fauna had become extinct (Martin 1984; Roberts 1989). A Palaeolithic optimum monthly alternation between dark moon seclusion and full moon completion of big game hunting predicted by the model would not be possible once big game plenty had come to an end. If the monument-building cultures of the Neolithic and early Bronze Age were in some way addressing earlier hunter-gatherer rituals, which is the present understanding in archaeology, then the continued viability of ancient conceptions of time and ritual practice may well have been called into question.

The new archaeology of the Neolithic interprets monuments and their associated burial and depositional practices as both continuing and appropriating to new purposes an earlier hunting material and symbolic culture. The new anthropology of the Palaeolithic locates that earlier culture amongst hunter-gatherers who synchronised their lives according to the bi-polar alternation of dark and full Moon. If these two models are consistent, then they

would predict that Neolithic and early Bronze Age beliefs would display a complex logic which simultaneously respects and transcends an ancient cosmology which in its astronomical aspects had focussed on the moon. By extension, this also implies that the Neolithic and early Bronze Age introduction of solar symbolism was to modify and transcend this earlier engagement with the moon. These predictions can be tested by archaeoastronomy.

## Archaeoastronomical models of late Neolithic and early Bronze Age monuments

For two decades or so after the mid 1960's, there was very little agreement among archaeologists and archaeoastronomers on the astronomical properties of Neolithic and early Bronze Age monuments (Ruggles 1999). The mutual incomprehension partly sprang from the inadequate models for the new astronomical data. Archaeologists, then largely wedded to a version of a farming Neolithic, assumed a lack of complexity for the period and looked askance at archaeoastronomers' claims that Neolithic monuments displayed astronomical properties. Some archaeoastronomers filled the vacuum with their own models, and suggested that 'astronomer priests' were using the monuments as scientific observatories to construct calendars and predict eclipses (Hawkins 1970; Mackie 1977; Newham 1972; Thom 1971; Wood 1980). A more cautious note was sounded by others, who suggested a ritual rather than a 'scientific' function for prehistoric monumental astronomy (Burl 1987; Renfrew 1976). It is this second approach that has stood the test of time. A maturing archaeoastronomy now accepts a 'religionist' (North 1996:10) or 'ethnographic' (Ruggles 2000b) rather than 'astronomer' model for interpreting monumental alignments. This shift within archaeoastronomy brings it closer to the new model of a protracted religious reversal of Palaeolithic and Mesolithic forager beliefs by a

'domesticating' Neolithic. Archaeologists, in turn, have moved towards a cautious engagement with the astronomy of monuments. As Thomas and others have pointed out, these constructions point to the meeting places of sky and earth, above and below, as well as to the surrounding landscape (Hoskin 2001; Ruggles 1999b; Sims 2001; Thomas 1999) and point to '... the fundamental importance of cosmology'. (Bradley 1998,150) To test the limits of this convergence, just as archaeologists have discerned themes of duplication, mimicry and reversal when comparing Mesolithic and Neolithic material culture, we would expect similarly a rich and complex vocabulary of astronomical allusions in monument design.

Over the last three decades one finding of this research is a tendency amongst the stone monuments of the late Neolithic and early Bronze Age in the British Isles to have an orientation towards the south-west which pair alignments on the setting winter sun *and* the moon at its southern standstill moonset limits (see below for explanation of terms). In at least five regional groups of monuments of the late Neolithic and early Bronze Age, in all accounting for 323 monuments, their main alignments focus on winter solstice sunset and the southern major or minor moonsets. These are: 64 Scottish recumbent stone circles (Ruggles 1999), 28 Clava cairns (Burl 1981), 189 West Scotland stone rows and 48 SW Ireland stone rows (Ruggles 1999), Avebury stone circle and Stonehenge's Phase 1, Phase 2 and Phase 3 (North 1996). At least one researcher has called attention to the especial emphasis on solar orientations in the winter half of the year for many Neolithic and early Bronze Age monuments (Prendergast 1995; Prendergast 1998). Although it may be an overly large claim best reserved for stone monuments, '[t]he evidence for prehistoric interest in obvious astronomical events such as midwinter sunrise and sunset is almost universally accepted.' (Ashmore 1999, 28)(See also Barnatt 1978; Burl 1976; Burl 1979; Burl 1988; Burl 1999). While this paper will concentrate on interpreting the astronomical

symbolism of sarsen Stonehenge<sup>17</sup>, we will see that its astronomy was the ‘same’ as 322 other monuments, including Stonehenge’s own two or three earlier incarnations.

## North’s Case Against a Sarsen Stonehenge Alignment on Summer Solstice Sunrise

Many commentators claim that when standing at the centre of sarsen Stonehenge (Figs. 1 & 2) and looking to the north east on summer solstice morning, the sun can be seen to rise over the Heel Stone (Atkinson 1979, 93-97). We now know that this is not just an anomalous claim for most stone monument’s main alignment in the British Isles of the late Neolithic and early Bronze Age, but that the claim is inconsistent with the known internal properties of the monument. The findings of North (1996) and others (Burl 2002; Newham 1972) provide many details to correct this misunderstanding. First, it is unclear where the ‘centre’ of Stonehenge lies. It is not marked by any stone (Cleal 1995; Ruggles 1999), nor is the Avenue aligned on the centre of the sarsen circle (Atkinson 1979). The absence of a precise viewing position is important, since even changing from one eye to the other alters the alignment by one-sixth of a solar diameter. In the absence of any criterion by which a central viewing position can be fixed, no definite alignment can be claimed. Second, standing at the centre of the sarsen circle, and looking through either eye, the summer solstice sun does not rise over the Heel Stone. This was not the case in the Neolithic and has never been the case. The sun has always risen by about three solar diameters (about 1.5°) to the left of the Heel Stone. Since other monuments of the period had higher levels of accuracy in their alignments, this is an unacceptable level of error for one of the greatest

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<sup>17</sup> This is the “stone monument” of sarsen circle and trilithons identified by Cleal as Stonehenge Phase 3ii, with an average calibrated date of 2413 bc (Cleal 1995: 524, 167, 204-5). The arrangement of bluestones within this and shown in Fig. 2 is Cleal’s sequence 3v, dated to about ‘the early second millenium’ bc (Cleal 1995, 231). While the arrangement of sarsens did not change throughout this sequence from 3ii to 3v, the end stones of the bluestone horseshoe did. The main axial alignment discussed in this paper relies on the sarsens only. I have used the term ‘sarsen Stonehenge’ for the monument 3ii – 3v throughout this paper.

of these monuments (North 1996; Ruggles 1999; Ruggles 1999b). Third, since it only requires two markers to establish a single alignment, the claim accounts for very few details of the monument. Stonehenge was once a complex arrangement of about 119 upright stones of graded heights, many lintelled and laid out in concentric circles and arcs, another four 'station' stones laid out in an encompassing quadrangle, and there were additional single standing stones now known as the Heel, Slaughter and Altar Stones<sup>18</sup>. Out of a total of what was once around 160 stones, about 158 would remain to be explained by separate and additional theories to that of a single summer solstice alignment. Fourth, when the now prostrate Slaughter Stone is stood upright from its present position, it entirely obscures the view of the Heel Stone from the 'centre' of Stonehenge, blocking any view of a Heel Stone alignment on the summer sunrise (Burl 1999, 139-149; North 1996, 421-424, 427-430, 468-470). This evidence, and more to be discussed below, severely weakens the claim that Stonehenge was ever meant to align on summer solstice sunrise(Ruggles 1997; Ruggles 1999)<sup>19</sup>.

## North's Case for a Sarsen Stonehenge Main Alignment on Winter Solstice Sunset

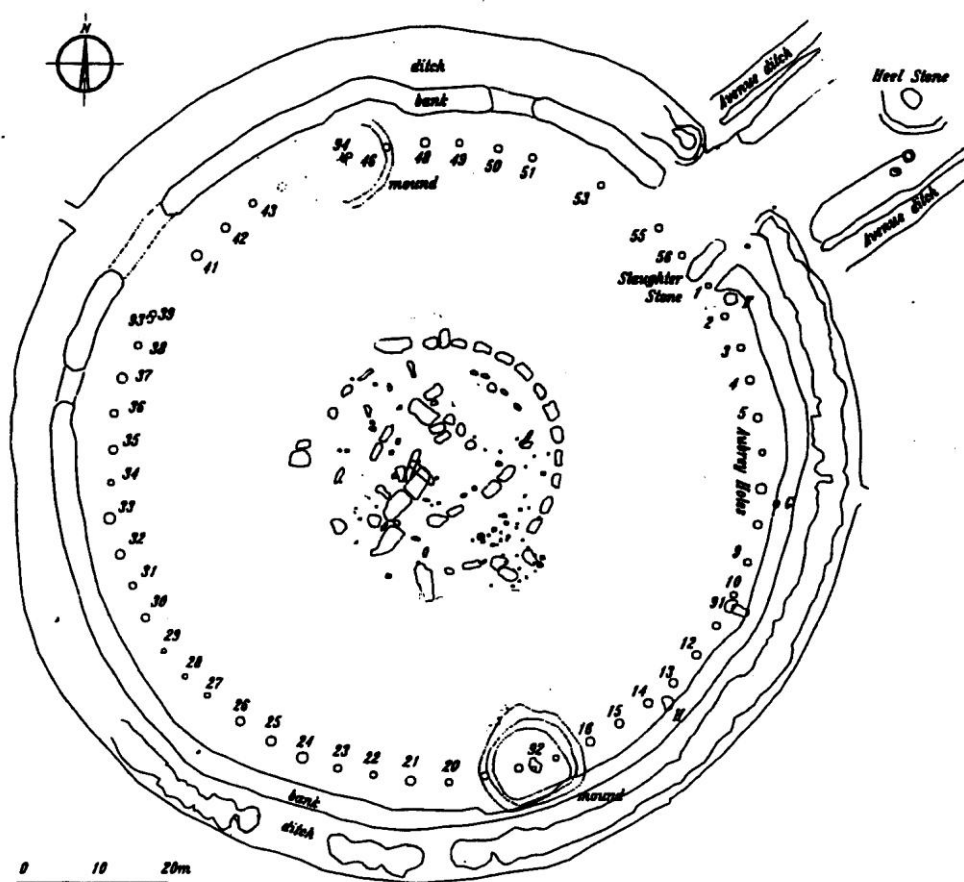
North (1996) has argued that the archaeology of Stonehenge suggests that its major alignment is not towards the north east, but in the reverse direction towards the south west onto winter solstice sunset. When today we look at a plan view of the monument we see many stone pillars arranged in concentric series of two circles and two arcs. In this view it appears to be gaps surrounding a space (Fig. 1).

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<sup>18</sup> See Chapter 10 of North (1996) for discussion of possible significance of other stones that may have acted as backsights.

<sup>19</sup> Ruggles (1997) gives the view for a summer solstice sunrise alignment, and Ruggles (1999) gives the view for a winter solstice sunset alignment.

Figure 1 Plan view of Stonehenge 3v

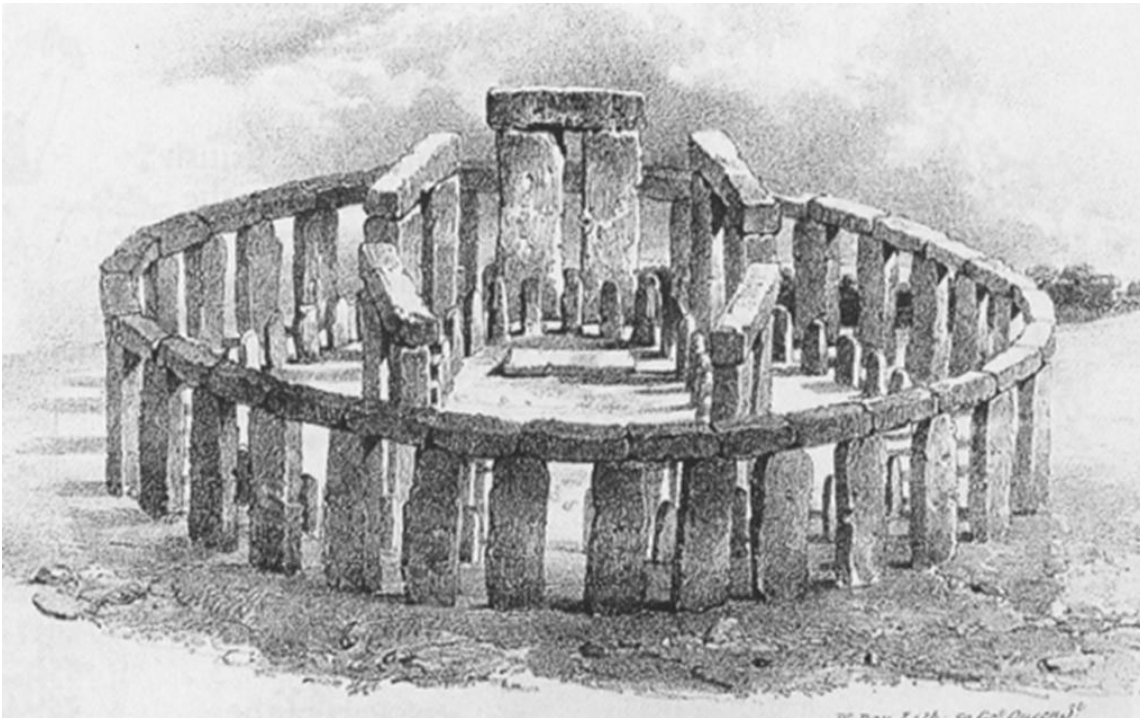


#### Note

1. The Avenue approaches the monument uphill from the North East.
2. At the end of the Avenue, just before it reaches the ditched enclosure, a late Neolithic observer's eye standing beside the Heel Stone is at the level of the centre of the monument.
3. The Slaughter Stone lies in a shallow ditch especially dug for it.
4. The Aubrey Holes, numbered 1-56, encircle the sarsen monument. They held posts in Phase 1 of the monument and, after the posts were removed, they were used as deposition pits in Phases 2 & 3.
5. The Station Stones, almost coincident with the Aubrey Hole circuit, are stones numbered 91-94.
6. The reader can cross reference this plan of the present positions of the remaining stones with the artist's recreation in Fig. 2.
7. Note how this plan representation of the monument gives no indication of the sloping site, or the lintels, or important individual features of many of the stones.
8. Adapted from North 1996, 410.



Figure 2 Stonehenge 3v



#### Note

1. Looking along the central axis, to the South West, from above the Heel Stone and Avenue (not shown).
2. The nearest sarsen uprights are stone number 1 to the left of the central axis, and stone number 30 to the right.
3. Stone number 11 is incorrectly drawn as the same uniform size as all the other outer sarsen ring uprights. In fact, it is half the height, width and breadth of the standardized size shown. Opinions differ as to whether this stone was originally intended to be half-size, or whether it has subsequently broken to this size. Nevertheless, this raises the possibility that the lintel circle may not have originally been a complete ring of stones.
4. Within the sarsen circle there stood what has been estimated to be 59 or 60 uprights of the bluestone circle.
5. The five trilithons are stepped in height towards the largest, the grand trilithon. Notice how the near trilithons converge symmetrically on a point. That point is the Heel Stone.
6. Within the trilithons of Stonehenge 3ii-vi are the 19 bluestones of 3v-vi repeating the shape of the trilithon's enveloping horseshoe. The bluestones, like the trilithons, are also stepped in height towards the south west.
7. The focus for the central arena in this representation is the prostrate Altar Stone. A more likely scenario, according to North, is that the Altar Stone was upright.
8. Not shown in this artist's recreation are the four Station stones, Slaughter stone, the Aubrey Holes, the encircling bank and ditch, the Heel Stone, and the Avenue (see Fig. 1).
9. Image from North 1994, 340 (with permission).

When looking at the monument outside the sarsen circle from the Heel Stone, North shows how the builders created the illusion that the monument appeared to be an almost solid block of stone (see also Pitts 2000, 135). They achieved this by adjusting the ratio of

the width of the stones to the gap between them, and by nesting the horseshoe arrangement of five trilithons within the sarsen circle. This design allowed the trilithons to block nearly all the gaps that otherwise would be seen through the sarsen ring. This paradox of an open monument appearing to be an almost solid block of stone obscuring the skyline is apparent when approaching the structure from the Avenue, as was intended, from 11 metres before the Heel Stone right up to the 'entrance' between stones 1 and 30. Stonehenge's main axis does not have this 'obscuration' property in the reverse direction, towards the north east and summer solstice sunrise (North 1996, 451-456; Sims 2003). A further property, also not obvious in a plan view of the monument, is that Stonehenge is built on the side of a hill which rises to the south west. This sloping location brings the observer's eye at the Heel Stone down to the level of the central area of the monument, so creating a very sharp single horizon which facilitates observation of the south-western sky (Bender 1998, 70). This is not the case when standing in the middle of the monument looking towards the north-east, from where the land first falls away into Stonehenge Bottom, and then rises and falls in two further horizons to a distant skyline, presently etched with tree cover. Standing at the Heel Stone, this apparently near solid monument reveals through its central axis a 'window' framed between the grand trilithon uprights aligned on winter solstice sunset. Within the darkening mass of stone at winter solstice sunset a Heel Stone observer would have seen a burst of light as the sun seemed to set into the Altar stone at the apparent centre of the monument.

Unlike viewing from the centre of the monument, many of its design principles recommend that we accept this winter sunset interpretation<sup>20</sup>. The surfaces of the monument have been engineered to present a clear-cut silhouette to an observer standing at the Heel Stone (Whittle 1997, 155). The converging inner faces of the nearest trilithons focus on the

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<sup>20</sup> Darvill (1997) gives a very different interpretation of the horizons around Stonehenge. See Pollard & Ruggles (2001) for a critique.

Heel Stone. The grand trilithon lintel, unlike the sarsen lintels, is wider at its top than at its bottom, so tipping its face forward at a right-angle to the Heel Stone line of sight (North 1996, 447)<sup>21</sup>. From the Heel Stone, the lintelled sarsen circle cuts out the glare of the sky without the cost of an enormously heavy superstructure, as in a passage tomb design like at Newgrange in Ireland (O'Kelly 1982). Immediately in front of the grand trilithon, the Altar Stone provides an artificial but durable horizon into which the sun will, if viewed from the Heel Stone, appear to set (North 1996, 460-465). And while the sarsen circle stands on ground that slopes by half a metre across its diameter, the top surfaces of the lintels are level to within an error of seventeen centimetres across the sarsen circle diameter of about 32 metres, so affording a level horizon to a viewer standing beside the Heel Stone (North 1996, 420).

Not just the engineering, but also the artistry of the monumental architecture orchestrates participants into the inner horseshoe *from* the Heel Stone. The trilithon and bluestone horseshoes are stepped in height in that direction, and towards the largest stones of the monument, the grand trilithon. These dramatic stones draw those walking along the processional avenue into the horseshoe and simultaneously entrain their gaze onto the south-western sky, then framed by the grand trilithon uprights. The assumption that we should be looking to the north-east is an artefact of plan viewing, not three-dimensional viewing, of the monument (Pollard 2001). A plan view gives no information about the height of the stones, severely diminishes the significance of the lintels and gives little indication of the slope of the land on which the stones stand. Neither does it allow an explanation for idiosyncratic properties of some individual stones. For example, the substantial dishing of the right hand side of stone 1 keeps the central axial alignment open when viewing the monument from the left hand side of the Heel Stone (Fig. 3). And it

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<sup>21</sup> As is the trilithon lintel stone 154 which is tipped towards an observer standing on the south-eastern quadrant of the Aubrey Holes. See plate on front cover to Cleal (1995).

would be a very odd ritual centre indeed if, once having turned their backs and walked away from the rising sun along the Avenue and into the monument, participants were then expected to turn round, ignore the monument, face back towards the rising summer solstice Sun, and observe it outside the monument probably emerging from behind some trees over two horizons away (Ruggles 1999b, 248). '[I]f the Altar Stone was the focus of attention and the Heel Stone ...marked the ceremonial entrance to the monument, it is certainly just as plausible, and arguably more so, that the alignment of particular symbolic value was that of the Altar Stone with the direction of mid-winter sunset in the south-west' (Ruggles 1999b, 138). Plausibility is enhanced if we factor in the view to an observer processing uphill past the Heel Stone into the centre of the monument (North 1996, 453). When approaching the monument from the Heel Stone, walking at a sedate pace at winter solstice sunset, the artifice is created of holding the setting sun still, the upward movement of the walker's eye exactly counter-balancing the sinking motion of the Sun.

## North's Case for a Sarsen Stonehenge Second Main Alignment on the Southern Minor Standstill Moonset

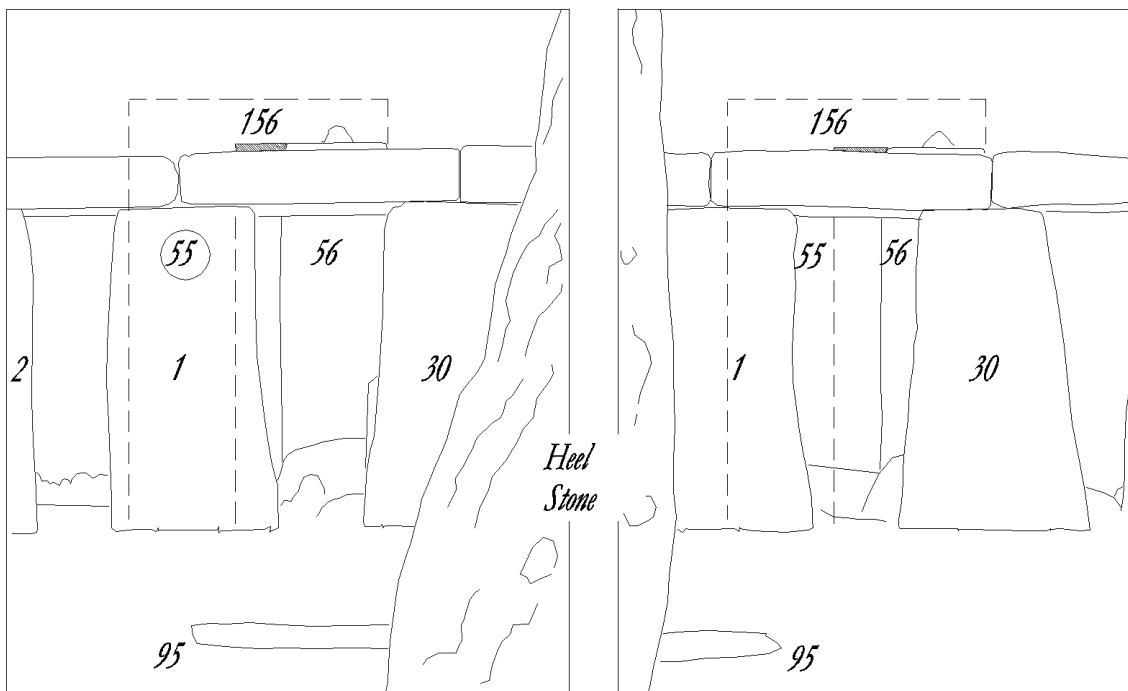
North shows that when Stonehenge is viewed from the Heel Stone there are in fact two 'windows', not one, that can be seen in the centre of the monument (North 1996, 454-459, 470-475). First, looking from the right hand side of the Heel Stone, a window can be seen framed within the grand trilithon uprights, themselves nested within the outer circle entrance stones below their lintel<sup>22</sup>. This lower window is aligned on winter solstice sunset.

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<sup>22</sup> North's view is that the Altar Stone was upright, and if so would have provided a raised and durable horizon into which the winter sun would have set. However, there is some evidence that it may have lain flat on the ground. See <http://www.ualberta.ca/~gfreeman/> for an interesting finding from some recent field research.

Second, but now looking from the left hand side of the Heel Stone, an upper window is framed again within the grand trilithon uprights but now between the upper surface of the closest lintel of the outer sarsen circle and the lower surface of the protruding grand trilithon lintel. This upper window, directly above the lower window, is aligned on the

Figure 3 Elevation views along the main axis of Stonehenge 3ii-vi, standing on the left and right hand sides of the (upright) Heel Stone



#### Note

1. Stones 55 and 156 of the grand trilithon have been reconstructed to fit the present setting of stone 56. North suggests that in 1901 Gowland may have re-set stone 56 'a hand-breadth's too deep.' (North 1996, 443) From my own inspection of this stone, it has also been twisted anti-clockwise out of alignment with the gap between stones 1 & 30.
2. The Altar Stone is not shown but, according to North, would probably have stood upright in front of the grand trilithon uprights, obscuring the lower portion of the bottom window.
3. A plan view of the monument cannot take account of many individual properties of some of the stones. This elevation view demonstrates how the dishing property of stone 1 keeps the view between the grand trilithon uprights, and therefore winter solstice sunset, open from the left hand side of the Heel Stone. If stone 1 were of a 'standard' shape, this would not have been the case.
4. The shaded portion beneath the grand trilithon lintel, stone 156, represents the upper window aligned on the southern minor standstill moonsets. Notice how this window is enlarged by left hand viewing from the Heel Stone.
5. Adapted from North 1996, Fig.170.

southern minor standstill setting moon (Fig. 3). The first alignment occurs once every year, but the second occurs only once every nineteen years. Recognising that these alignments

are made from either side of the Heel Stone lends significance to why its sides are parallel up to eye-level (Atkinson 1979).

These properties are testable. The alignments derive from properties internal to the monument alone, and do not rely on any prior assumptions about distant skyline notches, or other (possibly random) external features, to fix an astronomical alignment. It is an accident of Stonehenge's location that at Latitude  $51^{\circ}$  north an *accurate* orientation on winter solstice sunset yields in the reverse direction an *approximate* orientation on summer solstice sunrise. This effect is an unintended and fortuitous consequence of the monument's geographical position, which generates nearly  $180^{\circ}$  of separation between these different solstice sunrise and sunset points. If it comes to a choice between two precise orientations to the south-west and one approximate orientation to the north-east, it would be mistaken to choose the latter when so many properties of the monument suggest otherwise.

North's obscuration model manages to combine 28 properties of Stonehenge in a single argument<sup>23</sup>. A plan diagram cannot capture the illusion that in three-dimensional view from the Heel Stone the monument appears to be an almost solid object on an eye-level horizon. Avenue, Heel Stone, sarsen circle, trilithons, and Altar Stone, all contemporaneous for Stonehenge<sup>24</sup>, are integrated in a single parsimonious model. It is extremely improbable that this full suite of design characteristics, whose main rationale is to generate a double axial alignment on the winter solstice sunset and superior southern minor standstill moonset, can be explained away as a chance occurrence. It also provides a response to the challenge of a preferential selection of sightlines from the many offered

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<sup>23</sup> Ruggles (2000:73) sees the central 'solstitial axis' as equivalent in both directions.

<sup>24</sup> Ruggles (1998:87) suggests, referencing Cleal (1995), that they were not contemporaneous. However, Cleal shows that from Stonehenge 3ii to 3v it is the bluestones which are modified, not the sarsen pillars and lintels upon which these alignments depend.

by so many concentric pillars, since only two internal alignments are possible from the Heel Stone outlier and both are found to fit cosmologically auspicious events<sup>25</sup>.

Furthermore, the finding that the main orientation of the monument is on the winter solstice sun brings Stonehenge back into agreement with the emerging research consensus for late Neolithic and early Bronze Age stone monuments. The evidence seems to indicate that for stone monuments in particular this ancient cosmology generally emphasised winter over summer, and settings rather than risings (Ashmore 1999; North 1996; Prendergast 1998)<sup>26</sup>. Any ethnographic investigation into this cosmology must therefore address why ancient monumental alignments should be selecting not for when the sun is ascending at the start of the longest day, but for when it is descending at the start of the longest night.

## North's Explanation for Solar and Lunar Alignments at Sarsen Stonehenge

However, North's claim that Stonehenge also has a main alignment on moonset at the southern minor standstill is, on first acquaintance, perplexing. While the sun takes one year to complete its cycle of horizon rise and set positions from one winter solstice to another, the moon takes just 27.3 days<sup>27</sup>. Using a term which echoes the sun's solstice horizon movements, the moon's monthly horizon extremes are known as lunistics.

Besides the speed of the moon's horizon movements outpacing those of the sun, there is

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<sup>25</sup> This very real problem has been discussed using a statistical methodology in Ruggles (1999). However, even before a rigorous statistical procedure begins scaling assumptions must be made about what constituted the back sights and foresights in ancient monuments, and these decisions are based on an interpretation of their design which is not constrained by statistics. Seeing Stonehenge as an obscuration device drastically reduces the number of sightlines. Similarly, the obvious 'light-box' design at Newgrange is but another form of obscuration device, and statistical methods are inappropriate for such an obvious design property.

<sup>26</sup> Which is not meant to imply that summer alignments, and alignments on risings, don't occur in these and other monuments – just that they all belong to an integrating ritual syntax which, in the main alignments at stone monuments, seem to prefer soli-lunar pairings on winter settings.

<sup>27</sup> This is the sidereal month - the time taken for the moon to circle the earth and return to the same position in the sky marked by the fixed stars. As the earth is simultaneously circling the sun, it takes a further 2.2 days (the synodic month) for sun, earth and moon to realign, and so enable the phases of the moon to complete their cycle. See Thom (1971, 117) and McCluskey (2000, 9).

a second level of complexity to the moon's horizon movements that distinguishes it from the sun. Unlike the sun, the moon's extreme southern and northern horizon rise and set positions are not 'fixed'. On top of its rapid monthly alternation the moon's movements obey another long-period cycle in which its monthly horizon extremes of rising and setting gradually but radically change over a span of nineteen years. Once in this nineteen year period, during what is known as a major standstill, the moon reaches the maximum of its range of monthly horizon swings. At Stonehenge this is about<sup>28</sup>  $10^{\circ}$  further north and south of the horizon rise and set positions of the summer and winter solstice sun<sup>29</sup>. For about one year, the limits of the moon's northern and southern rise and set positions hover around these major standstill points. At no other time in its nineteen year cycle does the moon ever reach these most widely separated sections of the horizon. Over the next nine or so years, the extreme limits of the moon's rising and setting positions gradually reduce, until again they reach a 'standstill' point. Once again for about one year, the moon's monthly horizon limits stay in this standstill area, but now about  $10^{\circ}$  *within* the sun's extreme rise and set positions (Fig. 4). This second type of standstill is known as the minor standstill. Unlike during the major standstill, the moon can set in the region of the minor standstill throughout its nineteen year cycle. 'The only particular quality that can be associated with the minor standstill is that the directions...enclose the narrowest range in azimuth in which the moon rises and sets during any month' (Morrison 1980). It is for this reason that Thom labelled it the *minor* standstill (Thom 1971). However for some reason the builders of one of the greatest monuments of the late Neolithic and early Bronze Age went to extra-ordinary lengths to align the largest stones of the monument on precisely this 'minor' property of the moon<sup>30</sup>. If we can find some aspect to the southern minor standstill

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<sup>28</sup> Issues of precision are discussed later in the article. See Fig. 4 for precise values.

<sup>29</sup> This is the number of degrees (azimuth) in the horizontal plane. Declination is the number of degrees above or below the celestial equator. See North (1996).

<sup>30</sup> Thom (1971) suggests that in general the largest stone(s) of a megalithic monument indicate a lunar alignment.



that eludes some modern astronomers, then this might strengthen our confidence in North's claims for the 'astronomy' of sarsen Stonehenge. If, in turn, we fail to find some 'particular quality' in the southern minor standstill moonset, then this would suggest that North may be over-interpreting the monument's astronomical properties. North has his own explanation for their choice.

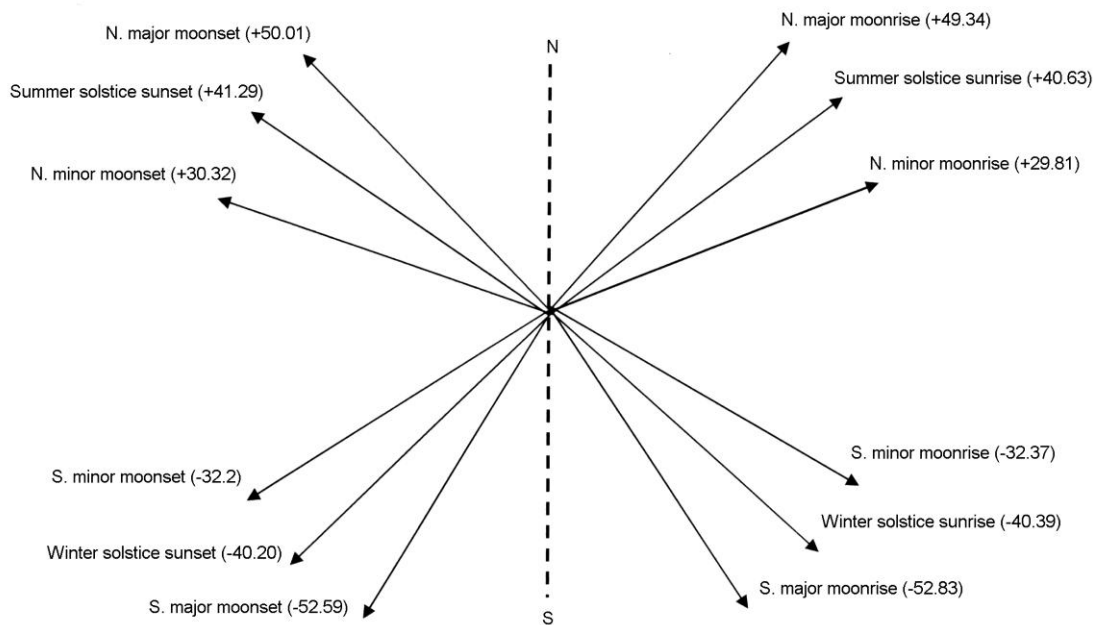
[T]he grand trilithon was so designed as to allow for two key observations from the Heel Stone, one of the setting midwinter sun at its base, the other of the setting moon at minor southern standstill at its top....And since the Moon's behaviour at this time might not be intuitively obvious, perhaps it is worth adding a brief description of what would have been seen before and after the minor standstill. As the moon set, its last glint within the window would have gradually shifted, day by day, from the right-hand end to the left, and it would then have reversed. At other times, it would not have reversed, and would have gone on setting further and further to the south. If this second type of behaviour was regarded as 'normal', then a minor standstill has a touch of the miraculous about it, and perhaps this was the reason for paying so much attention to it. (North 1996, 474-475)

### Problems with North's Explanation for Sarsen Stonehenge Main Alignment on the Southern Minor Standstill Moonset

North's explanation poses as many problems as it might solve.

First, if it were the case that the southern minor standstill moonset was considered 'miraculous' by Stonehenge people, why is it that North makes very different claims for the stone circle at Avebury just 20 or so miles away? For this monument, contemporaneous with Stonehenge, he suggests that the lunar alignment of the inner northern circle is on moonrise at its northern major standstill, and for the inner southern circle on moonrise and moonset at its southern major standstill (North 1996, 275). Why would the southern minor

Figure 4 Plan view of natural horizon alignments on sun's solstices and moon's standstills at Stonehenge 2,500bc



Note

1. N = north; S = south.
2. Bracketed numbers are degrees above or below the west-east axis.
3. Horizon alignment on upper limb of sun and moon.
4. Natural horizon altitudes in degrees at Stonehenge: NE 0.60 SE 0.70 SW 0.60 NW 0.30.
5. Data from North 1996, Appendix 3.

standstill moonset be ‘miraculous’ at Stonehenge but not at Avebury? If we find alignments on a variety of lunar standstills across late Neolithic and early Bronze Age monuments, then a stronger explanation would be one that did not privilege one type of standstill as miraculous over all others. That would allow Stonehenge’s lunar alignment to be just one variant, albeit a spectacular one, of a general engagement in late Neolithic NW European cultures with some more essential property of *all* types of lunar standstill.

Second, it may be the case that the builders of Stonehenge considered the moon’s direction reversal at the southern minor standstill ‘miraculous’. But the southern minor standstill is not unique in that respect, since the moon reverses its direction at *every* standstill (Morrison 1980). North is calling attention to a small perturbation of the moon’s movements at its lunistics’ extremes (see below and Ruggles 1999, 60). Therefore, if direction reversals of this sort are ‘normal’ for the moon at any standstill, and not a particular property of the southern minor standstill, then this weakens any confidence in the claim for a special ‘miraculous’ property to the southern minor standstill movement reversal.

Third, to judge the forestalled southern swing of the minor standstill moonset extreme as ‘miraculous’ suggests that North is using a solar template for judging the moon’s movements. Sunsets never interrupt their progress along the western horizon to its south-western or north-western limits. It is only by taking the sun’s more pedestrian horizon movements as ‘normal’ that could possibly allow us to judge the moon as ‘miraculous’ when, unlike the winter sun, at the southern minor standstill it stops short of its full range to the south west and temporarily reverses its direction. But if the builders of Stonehenge did perceive the southern minor standstill moonsets this way, it cannot account for why the

builders of Avebury stone circle selected the southern *major* standstill of the moon which has an *extended* southern horizon swing.

Fourth, if it is the case that a sense of ‘magic’ is created when southern minor standstill moonsets stop short of their full range, then this is equally true of the northern minor standstill moonsets. To explain its selection by the builders of sarsen Stonehenge, the southern minor standstill must therefore possess some property beyond the forestalled horizon swing which it shares with northern minor lunar standstills.

To grasp these points we need to pause awhile to compare the horizon astronomy of the sun and the moon.

## The Horizon Properties of Solstices and Standstills

At the latitude of the British Isles on summer solstice the sun rises in the north-east and sets in the north-west. At the winter solstice the sun rises in the south-east and sets in the south-west. The sun therefore has two solstice points on the eastern horizon and two on the western horizon. At a major standstill the moon will rise in the north-north-east and set in the north-north-west. Thirteen to fourteen days later, during that same major standstill, the moon will rise in the south-south-east and set in the south-south-west. For the moon therefore, the major standstill alone has four ‘lunistice’ points on the horizon. At a minor standstill of the moon there will be another four horizon points for the rising and setting moon, although now within the Sun’s solstice horizon extremes. The moon therefore has eight, not four, horizon ‘points’ that mark its horizon boundaries (Fig. 4)<sup>31</sup>. There are further

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<sup>31</sup> All these horizon points are marked by modern positional astronomy using *declination* measures – the angular separation of a body’s movement in the sky **above or below** an imaginary arc of the earth’s equator

differences between solstices and lunistics. When the sun sets at the solstices it is apparently stationary for about a week. The unaided eye cannot detect any change in the sun's horizon setting position for three days either side of the solstice (Allen 1992). In its pendulum-like movements before this 'stationary' period, the winter sunsets are very slowly setting further to the south, and three days after the winter solstice sunsets slowly start to set further to the north. The sun's movements are therefore characterised by *daily* incremental change interrupted by over a week at the solstices when the sun apparently occupies a stationary position on the horizon at sunset. North seems to suggest that standstills are the lunar equivalent of the sun's solstices, for at the southern minor standstill in the grand trilithon 'upper window' at Stonehenge the setting moon 'would have gradually shifted, day by day, from the right-hand end to the left, and it would then have reversed' (North 1996, 474-475). This is not the case. It is an over-simplification from conceptualising a horizon alignment on the moon's 'standstill' as if it were the lunar equivalent to a horizon alignment on the sun's solstice. While in some *symbolic* respects we will see that this may have been an intended *Neolithic* deceptive conflation, some important *real* differences must first be understood, if only because North relies upon them

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projected onto the celestial sphere. For us today at summer solstice, the sun's path across the sky prescribes an arc  $+23.45^\circ$  above the celestial equator, and therefore sets at its north-western horizon extreme. At winter solstice, when the sun is  $-23.45^\circ$  below the celestial equator, it sets at its south-western horizon extreme. At the latitude of Stonehenge in 2500BC, the winter and summer solstice sunsets swing between declinations of  $\pm 24^\circ$ . At major standstills for the same period the moon sets within monthly extremes of  $+28.25^\circ$  to  $-30.0^\circ$  degrees of declination, and about 9 years later at minor standstills between  $+18.0^\circ$  and  $-19.65^\circ$  degrees (Ruggles 1999, 57). The moon's range of setting positions over a nineteen year period therefore straddle, on this measure, by about  $5^\circ$  of declination above and below the sun's solstice setting positions. However, a more appropriate measure is azimuth, which is a measure of the swings of the sun and the moon **to the left or right** on the horizon. For example at Stonehenge in 2500BC, and assuming a level horizon of zero altitude, while the winter sun set  $230.49^\circ$  from north, the southern major standstill moonset was at  $218.28^\circ$ , and the southern minor standstill at  $238.41^\circ$  from north. The angle of azimuth of the moon's lunistic swings are therefore about  $10^\circ$  either side of the sun's solstice setting positions, or approximately double the value measured by the angle of declination. Declination measures, since they assume a celestial equator girdling the planet Earth, are consistent with a heliocentric model of the solar system. Measures of azimuth (combined with horizon altitude) are more in keeping with not just a geocentric vision of the cosmos, but of a planar earth sandwiched between the sky above and the underworld below. Since this second view is far more likely to coincide with a prehistoric view of the cosmos, azimuth measures should be preferred over declination measures. Confusingly, since archaeoastronomers use both declination and azimuth (combined with horizon altitude) interchangeably for locating the position of the sun and moon, and since crucially different levels of meaning are implied by each, any untangling of modern from prehistoric assumptions nevertheless require us to engage with both.

for his own interpretation of short period horizon reversals. For the moon sets at its south western horizon limit only once every 27 nights, and does not stay at this position for a week as do the winter solstice sunsets. The very next night moonsets begin to move to their north western horizon limit, arriving there 13 or 14 nights later to then immediately start moving southwards again to return to its south western limit. Therefore, unlike the sun, the south western limit to the moon's horizon setting point is not characterised by a week in which the moonsets appear 'stationary'. To observe southern lunistice moonsets requires watching a series of episodes every twenty-seventh moonset in a time-lapsed observation exercise<sup>32</sup>.

## Evaluation of North's Primary Explanation for Sarsen Stonehenge Main Alignment on the Southern Minor Standstill Moonset

According to North observing these monthly southern minor moonsets over a standstill year in the grand trilithon upper window reveals systematic sinusoidal perturbations in the horizon lunistice positions of the Moon.

As the moon set, its last glint within the window would have gradually shifted, day by day [sic], from the right-hand end to the left, and it would then have reversed. At other times, it would not have reversed, and would have gone on setting further and further to the south. (North 1996, 474-475)

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<sup>32</sup> Using the language of Darwinian signaling theory, the solar signal is redundant and the lunar signal is cryptic (Krebs 1984).

This property of the southern minor lunar standstill is represented in Fig. 5<sup>33</sup>. Twice every nineteen years, at the major and minor standstills of the moon, when the larger horizon movements of the moon have ceased for a period of about one year, this perturbation alone accounts for the variation in the horizon limits of the moon's rise and set points. There is, however, a problem claiming that this property can be observed on the horizon. North, in keeping with most archaeoastronomers, has assumed that the seasonal oscillation of geocentric *extreme* declinations<sup>34</sup> is repeated at moonsets on the *horizon*. The vertical oscillation shown in Fig. 5, he suggests, would be translated as a horizontal alternation in the upper window of the grand trilithon every three or four lunistics. Unlike the movement of geocentric extreme declinations at a major standstill, the seasonal alternation of all minor standstills would display, claims North, a foreshortened horizon swing at the solstices. However, the extreme geocentric declinations of the standstill moon occur, almost invariably, during its transit in the heavens before or after the time it sets on the horizon. To extrapolate the moon's position from its mid-transit extreme to the horizon position of moonset is complicated by the fact that unlike any other body in the sky the

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<sup>33</sup> A number of points need to be made when interpreting this representation of the moon's standstill geocentric extreme movements. First, for the southern minor standstill, shown on the bottom of Fig. 5, the moon's horizon setting positions oscillate in a region of about  $-18^{\circ} 20' \pm 10'$ . It can be seen that every other standstill has a similar  $20'$  oscillation depending on whether it is a major or a minor standstill, and whether it is at its southern or northern extreme. Second, the vertical axis is cropped in the Figure, so bringing the north and south lunistic moons into close proximity, when of course they take place at opposite horizon extremes, approaching the south and north of both the western and eastern horizons. Third, the moon's path is measured by its geocentric declination, which is a measure of the distance in degrees from the celestial equator to *centre* of the lunar disc. It is agreed by all archaeoastronomers that normally Neolithic observers tracked the first and last glint of sun and moon, and therefore the upper limb, not the centre, of the moon's disc. Fourth, the lunar disc is not shown to scale. The moon actually subtends an angle of about 30 minutes of arc, half of one degree, not the 5 minutes of arc shown on the Figure. The scale reduction of the moon in this Figure therefore exaggerates the scale of oscillation compared to the size of the moon. Fifth, the total perturbation of the moon at a standstill is about twenty minutes of arc by *declination*. When instead we measure this perturbation by horizontal swing (*azimuth*) the movement is about 40 minutes of arc. Sixth, since the moon's geocentric extreme takes place in mid-transit, and since the moon is constantly changing its position, by the time the moon reaches the horizon these values have changed. The net effect is again to underestimate the variation and imply a false sinusoidal shape to the perturbation. Seventh, it will be noticed that besides giving point estimates of the extreme declinations of the moon, Morrison has also provided the appropriate lunar phase of each lunistic by date. This categorical level information, not given elsewhere in the literature, is more amenable to ethnographic de-coding.

<sup>34</sup> Modern positional astronomy uses a formula from spherical geometry to calculate these geocentric values of the Moon's perturbation at the moment of its extreme, and on the assumption that the observer is standing at the centre of the earth. Neolithic observers, however, aligned their monuments on the moment the moon rose or set on the earth's horizon. As we will see below, this is not the moment of the Moon's extreme perturbation.

moon is constantly changing its declination. By the time the moon sets it is no longer at its extreme declination value but usually at some lower value. And since the time-lag between the moment of the extreme declination of the moon and time of its horizon setting is not the same each month, there is no strict correspondence between the seasonal sinusoidal alternations of the moon's extreme declinations in mid-transit with the horizon movements of moonsets. This substantially transforms the *horizon* pattern of seasonal alternation, so that the regular and seasonal wavelike motion of the extreme lunar perturbations shown in Fig. 5 cannot be observed on the horizon at all. Nevertheless, it is generally assumed within archaeoastronomy that prehistoric sky-watchers *aspired* to identify these extreme declinations of the moon. This assumption is a misunderstanding from Thom's founding work on the subject and an artefact of modern astronomer's use of geocentric declination to measure the path of heavenly bodies.

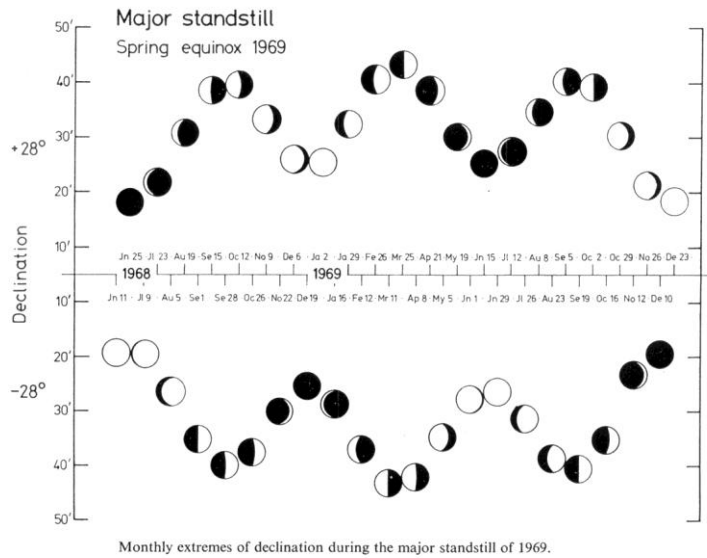
## Evaluation of Thom's View that the Function of Ancient Monumental Lunar Alignments was to Predict Eclipses

North West European late Neolithic and early Bronze Age monumental alignments on lunar standstills were first systematically studied by Thom in 1971. Thom concentrated on major standstills, and hardly considered minor standstills at all. Even when considering major standstills, he did not separate out the southern from the northern standstills. Instead, by mathematically combining the measures of both southern and northern major standstills he maximised the number of data points to investigate the properties of *major* standstills *in general*. This allowed him to test his preferred theory that megalith builders were able to predict lunar or solar eclipses. The period between each crest of the Moon's

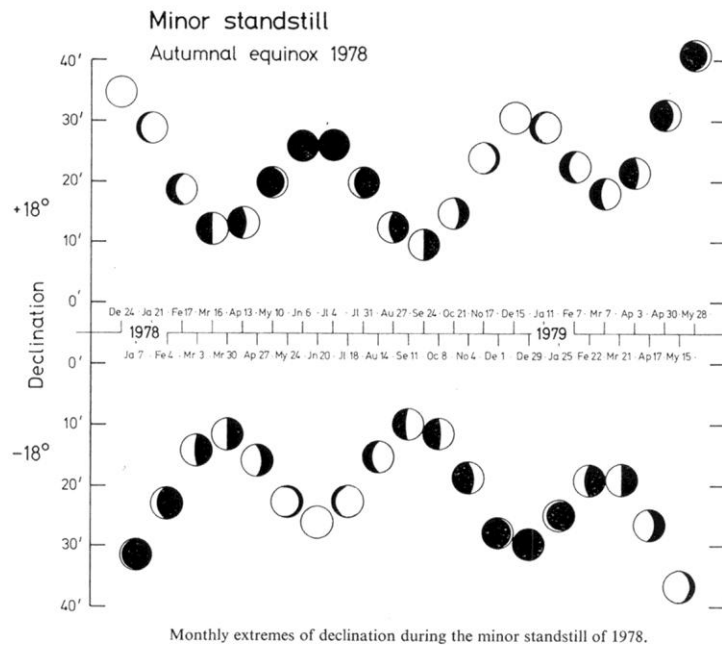


Figure 5 Monthly (geocentric) extreme declinations of 1969 major standstill and 1978 minor standstill, by date and lunar phase

a.



b.



#### Note

1. See text for the many precautions that need to be taken before interpreting this figure.
2. Month here means *sidereal* month, that the geocentric extreme declination occurs during the moon's mid-transit, not at the moment of horizon rise or set, and horizon movements are measured by azimuth not declination.
3. Adapted from Morrison 1980.

perturbation, shown on Fig. 5, is 173.3 days. Each time the moon reaches these extreme points in its perturbation, it crosses or approaches very close to the plane of the sun and the earth. These are the circumstances that create an eclipse. It was Thom's view that additional structures, 'extrapolation devices', accompanied some lunar-aligned monuments to estimate an interpolated 'true' mid-transit value from the observed horizon value, and so calculate the 173.3 day geocentric extremes shown in Fig. 5. Knowledge of this sinusoidal perturbation of the geocentric extremes, calculated from such devices, he thought would indicate an ability to predict eclipses. Archaeologists met these claims with extreme scepticism, so much so that archaeoastronomers entered a long period of field work and debate as to whether megalithic monuments were able to map these geocentric extreme movements of the lunar perturbation, or in fact whether they were aligned on lunar standstills at all. After two decades the conclusion was reached that in fact many of the monuments were aligned on lunar standstills, but that there was no evidence for the existence of 'extrapolation devices' (Heggie 1981b; Hoskin 2001; Morrison 1980; Ruggles 1999; Thom 1971). Nevertheless horizon alignments up to levels of accuracy of about 6'<sup>35</sup> of arc are considered to have been made at some late Neolithic and early Bronze Age monuments (Ruggles 1999, 227). This poses the question as to the purpose of these accurate monument alignments. It might be more useful if, instead of using the modern understanding of a lunar standstill measured and defined by its *mid-transit* geocentric extreme declination values, we search for other properties that may be associated with *horizon* azimuth alignments on a lunar standstill.

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<sup>35</sup> The Babylonian system divides a circle into 360 degrees (360°), one degree into 60 minutes (60'), and one minute into 60 seconds (60").

## Evaluation of North's Secondary Explanation for Sarsen Stonehenge Main Alignment on the Southern Minor Standstill *Full Moon*

Even though he has identified the main Stonehenge lunar alignment to be on the southern minor standstill moonset, surprisingly North suggests that megalith builders in general, including those who built Stonehenge, preferred alignments on major standstills or northern minor standstills (North 1996, 563-567). This claim reflects either an imputed concern for the unusual angles of major standstill extreme horizon alignments (whether southern or northern), or for luminosity, because northern standstill moonsets (whether major or minor) generate a full moon at winter, or for both extreme alignments *and* luminosity, as is the case with the northern major standstill full moonset at winter solstice (Fig. 5). These may well be the modern (and therefore possibly ethnocentric) preoccupations of astronomers that, while true, do not exhaust the properties of lunar standstills<sup>36</sup>. But the upper window of the grand trilithon is aligned on the southern, not northern, standstill and this generates a full moon at summer solstice, not winter solstice. When the full moon is seen to descend into this upper window at summer solstice, the 'fine slit' below the grand trilithon lintel frames just 'the upper limb of the moon' as it descends behind and 'into' the centre of the monument (North 1996, 472). According to North's figures the height of this slit subtended an angle of about 8' of arc, or about one quarter of the lunar disc (North 1996, Fig 170). If this was the case, since the lunar disc subtends an angle of about 30' of arc, then the grand trilithon window box was in fact never designed to frame the full moon, northern or southern, but just a descending sliver of the moon. On all three counts – by alignment on the southern minor standstill, consistency with the winter solstice sunset, and the dimensions of the grand trilithon upper window – the monument

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<sup>36</sup> To be fair to North, these same assumptions are shared by most researchers in the field. See for example Ruggles 1999; Thom 1967; Burl 1981.

details press us to reject the interpretation that the builders of sarsen Stonehenge were focussed upon full moon.

## The Emergent Properties of Soli-Lunar Double Alignments

We have rejected the five current archaeoastronomical theories for the main alignments at Stonehenge. Selection for summer sunrise, the horizon extremes of the moon, forestalled horizon moonsets, eclipse prediction and full moon have all been found inadequate when set against the known archaeological details of sarsen Stonehenge. Since the pairing of winter solstice sunset and southern minor standstill moonsets remains unexplained, let us approach the matter of lunar standstills anew.

In his characterisation of the ‘miraculous’ properties of this standstill, North does not incorporate into his interpretation all the information in his own findings. The defining design property of the monument is tiered lintelled pillars in concentric nested circles and arcs. This design created an ‘obscuration device’ which allowed a lower window set by the grand trilithon uprights to be seen directly below a second upper ‘horizon’, or window, framed by the grand trilithon protruding lintel. Sarsen Stonehenge manipulated *two* horizons, one above the other, in a *double* alignment from *one* viewing position – the Heel Stone<sup>37</sup>. Not to investigate the astronomical properties of this *double* alignment would therefore be to deny the central architectural principle of the monument. But North discusses the astronomy of each alignment, winter solstice sunset and southern minor standstill moonset, as *separate* alignments, and does not investigate the emergent properties of their *association*. This is, in fact, a fruitful exercise, and allows us to test

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<sup>37</sup> See North (1996: 434-502) for a discussion of other, possibly earlier, viewing positions in the vicinity.

competing hypotheses for the possible cosmological motivations of the builders of the monument.

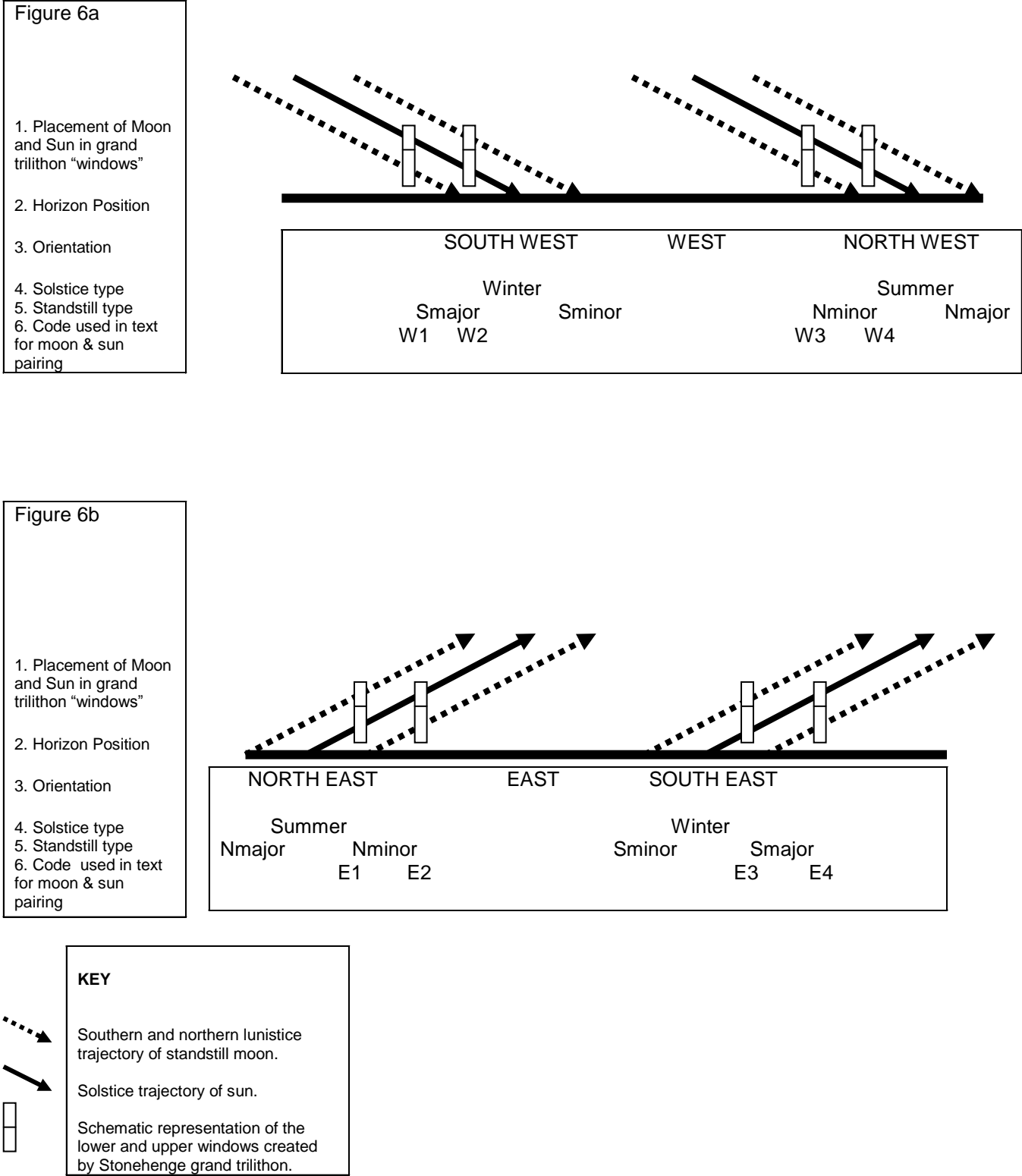
Duplication is built into the monument's design, as in the replication of the trilithon horseshoe by the bluestone horseshoe, and the sarsen circle by the bluestone circle. Each closely juxtaposed arrangement of stones mimics, in different registers, the other. To construct a binary monument that has a double alignment for both the sun and the moon suggests that some association between them is being sought. If the intended association was merely complementary, then this could have been achieved with two separate and unconnected alignments without the need for doubling them along a single axis through the challenging architecture of concentric and nested circles and arcs of tiered lintelled pillars. But as these two largest bodies in the sky happen to be of the same apparent size, and as they are being brought into a single alignment along the central axis of the binary monument that sarsen Stonehenge is, then this suggests that their properties are being symbolically conflated, not just combined, in a relation of identity. If other characteristics of their pairing suggest a selection for identity, then this will add strength to this hypothesis. As we have discounted North's suggestion of a seasonal alternation in standstill lunistice moonsets, there remain three possible dimensions of the shared properties of the sun and the moon in a double alignment: the placement of the moon above or below the sun, sharing the 'same' position on the horizon, and other emergent properties from a combination of these two. Let us look at each aspect in turn.

## Placing the Moon Above the Sun

For a double alignment to pair a lunar standstill with a solstice sunset along a single axis as at sarsen Stonehenge, it depends on which lunar standstill is chosen which will

determine whether the sun or the moon is above the other. There are theoretically eight possible double alignments of the sun and the moon along a single orientation in one direction at the solstices (W1-W4 and E1-E4 in Row 6 of Figs. 6a & 6b). What is very interesting is that in their selection of the monument's main orientation the builders of Stonehenge did not use the same engineering and architectural skills for the other seven possible combinations of the sun and the moon. Three of these other orientations would also have the moon above the Sun, but then bracketed either with summer solstice sunset (W4), or with winter solstice sunrise (E3), or with both summer and sunrise at summer solstice sunrise (E1). These are three paired associations that were rejected by the builders. One of these three paired orientations could have been the southern minor standstill moonrise with the winter solstice sunrise (E3), but even though in this case the moon is above the sun, and it is the time of winter solstice, and it is the 'miraculous' minor standstill, the condition of impending daylight is not what the builders wanted. There are four possible paired alignments with the sun above the moon (E2, E4, W1, W3), and one of these (W1) would pair winter solstice sunset with the southern major standstill moonset. This meets the chosen condition of winter solstice at sunset with the one difference that the southern major standstill places the moon below the sun. So even though the major standstill horizon point is a 'particularly impressive' position compared to the minor standstill horizon point, this seems to be a quite secondary consideration to the quality chosen by the builders that the moon should be above the sun in a paired alignment. Therefore the builders have chosen out of eight possible juxtaposed alignments the one which brackets the setting moon with the winter solstice sunset (W2) as long as the moon is above the sun. Any other pairing which brackets the moon with summer, or with the start of daylight, or in an inferior position to the sun, was rejected.

Figure 6 Schematic representation of the eight possible horizon pairings of the sun's solstices and the moon's standstills



## Horizon Position as Proxy for Timing Ritual at the Longest, Darkest Night

For every type of standstill, not just the southern minor standstill, there is a one year period during which lunar phases synchronise with the binary logic of solstice alternation. It will be seen that at the solstices the southern standstills, whether they are major or minor, always present a full moon at the summer solstice and a dark moon at the winter solstice (Fig. 5). Contrarily, at northern standstills, whether they are major or minor, dark moons always take place at the summer solstice and full moons at winter solstice (Fig. 5)<sup>38</sup>. This suggests that the rejection of the northern major or minor standstill moonsets is not just because it is bracketed with the summer solstice sun, nor that the northern minor standstill moon is rejected because it is below the sun, but because *all* northern standstill moonsets generate a *full* moon at winter solstice<sup>39</sup>. In the choice of the southern minor standstill moonset doubled with winter solstice sunset at Stonehenge the entire suite of characteristics exhibited by northern standstills (summer, inferior position, full moon) was rejected, and so achieved a pairing of the setting winter sun with a guaranteed *dark* Moon. Therefore, at Stonehenge the winter solstice sunset is bracketed with the southern minor standstill moonset, and this will ensure that once every 19 years, the winter solstice sunset is associated with the dark moon at the start of the longest and *darkest* night of the year<sup>40</sup>. This interpretation is strengthened from the findings of other researchers of hundreds of stone monuments mentioned above which, by other architectural means, double the

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<sup>38</sup> Full moon is seen on Earth when the sun is opposite the moon. Therefore full moon rises at sunset. Since the winter sun rises in the south east and sets in the south west, then full moon will rise and set in the north east and north west during winter. The reverse, of course holds during summer. In the annual 'dance' of the sun and the moon, during the winter the full moon will be high in the sky when the sun is low, and during summer the sun will be high when the full moon will be low. This general relation is independent of the nineteen year nodal cycle

<sup>39</sup> Burl, North and Ruggles all assume that *full* moon was the object of interest.

<sup>40</sup> As we will see, if we adopt an anthropological rather than astronomical approach to a lunar scheduling of ritual, this does "make sense", contra Ruggles 1999, footnote 141.



setting winter sun with the southern major or minor standstill moonsets and which therefore also focus their double alignments on the longest, darkest night.

## Attenuation and Reversal of Monthly Lunar Phases to an Annual Solar Timescale

This bracketing of winter solstice sunset with dark moon suggests, by extension of the principle of identity, a coding in which winter solstice sunset is being invested with the lunar phase property of dark moon. All that remained to be seen in this upper window at the southern minor standstill would have been the *grouping* of all thirteen<sup>41</sup> southern lunistice moonsets within this space, and this would *only* have happened during the minor standstill.

In fact, it can be seen from Fig. 5 that the respective phases of each of the thirteen lunistics during a standstill is appropriate to a full synodic lunar cycle, but attenuated over a year and reversed in their sequence<sup>42</sup>. Most of these thirteen southern minor standstill lunistice moons would have been observed apparently descending into the upper grand trilithon 'window box'<sup>43</sup>. An alignment on a lunar standstill, unlike on the sun's solstices, is therefore immediately a *multiple* alignment which theoretically identifies thirteen, not one, of the moon's lunistics. The moon's lunistics at a standstill are therefore scrolling in reverse order through a full suite of phases normally associated with a lunar (synodic) month, but now taking one year to unfold. The same reverse sequencing of lunar phases

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<sup>41</sup> While archaeoastronomy texts imply all 13 in their graphical displays of standstill lunistics, as we will see below it is actually only about nine.

<sup>42</sup> This is a result of choosing to observe the moon by its horizon lunistice movements, which correspond to the sidereal month of 27.3 days, rather than by its phase, which correspond to the synodic month of 29.5 days. Each lunistice's phase will therefore precede by about 2.2 days the completion of the full lunar cycle of monthly phases. Abstracting out the standstill lunistice Moons over one year will scroll its phases backwards by about 2.2 days each month, so giving the appearance of a reversed sequence of lunar phases. Only at a standstill do full and dark moons coincide with solstices.

<sup>43</sup> About 9 would have been observed. See discussion on lunar visibility below.

takes place during the southern major standstill<sup>44</sup>, although of course those moonsets take place further south on the horizon about nine years later. Special to both southern standstills is the way the phase-locking of an abstracted, attenuated and reversed lunar cycle selects dark moon to synchronise with the winter solstice<sup>45</sup>. However, the southern major standstill would not have allowed the moon to be placed above the sun with the technique of tiered, nested and lintelled pillars. Therefore we reconfirm the original inference that Stonehenge builders are attempting to optimise the properties that can be shared by the sun and the *superior* moon in their selection of the southern minor, *not* major, standstill. We can conclude that the builders selected this alignment on the moon as the main alignment at sarsen Stonehenge since it allowed them to place the moon above the sun, and associate the sun's winter solstice setting with dark moon as the culmination of an annual selected sequence of lunar phases which replicate those of a reversed synodic month, and which provide a reliable indication of a guaranteed longest, darkest night.

## Complication of Variable Lunar Visibility

It is necessary to qualify astronomers' claims that a lunar standstill is the sum of all possible lunistice alignments, as this provides an important insight into our understanding of the proposed 'annualised' standstill moon. Morrison's (1980) rendition of the four types of lunar standstills, shown in Fig. 5, is a computer-generated abstraction. While it shows the lunar phase, and therefore relative brightness, of each lunistice moon, it does not account for the variable effect of the sun's glare in obscuring the crescent moons. The

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<sup>44</sup> As do northern major and minor standstills.

<sup>45</sup> It will be noticed that northern standstills exhibit an identical property, although one in which dark moon now synchronises with summer solstice. North shows that when standing in the south east quadrant of Aubrey Holes, this secondary paired alignment of identity can be seen threading the nested lintels of the monument, although now the summer sun sets above the northern minor moonset.

consequence of this effect is to make certain settings and risings of crescent moons invisible to naked eye observation<sup>46</sup>. Only the full moon rises at sunset and sets at sunrise, its full transit therefore taking place through the night sky. Dark moon rises and sets with the sun and obviously cannot be seen. Between these two extremes, the moon's transit in the sky is partly during the day and partly during the night. Waxing crescent moon sets after sunset and becomes visible only with the setting sun, but cannot be observed rising in the morning sky against the glare of the already risen sun. Waning crescent moon rises before sunrise, but becomes invisible in sunlight for the rest of the day. Therefore waxing crescent moons can be observed at their settings and waning crescent moons at their risings, but not vice-versa. Since the sarsen Stonehenge main alignment is on the southern minor standstill moonsets, not moonrises, then this allows observation of waxing crescent moons but not waning crescent moons<sup>47</sup>. About twenty-seven days before winter solstice, the slim crescent of new moon will be seen from the Heel Stone descending in the grand trilithon upper window to be followed, in the reversed sequence of lunar phases, by dark moon at winter solstice. However the three or four southern standstill lunistics after winter solstice, all reversed waning crescent moons up to third quarter moon, cannot be observed setting in the grand trilithon upper window. Monument alignments on southern lunar standstills will therefore allow about nine, not thirteen, sightings on moonsets from spring equinox to winter solstice, whereas monument alignments on northern lunar standstills will similarly allow nine sightings on moonsets, although now between autumn equinox and summer solstice. Sarsen Stonehenge is therefore a centre for ritual at which the main alignment standstill moon's role culminates and *ends* with a winter solstice dark moon.

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<sup>46</sup> I have used the computer programs Redshift, Starry Night, Lunar Phase and Skymap Pro. None of them simulate this effect. While mentioned by North (1996: 564-566), it only became clear to me by clambering onto the roof of my house and looking for the waxing and waning crescent Moons.

<sup>47</sup> Of all the primary and secondary alignments at sarsen Stonehenge, North (1996: 489), suggests that all are settings with the one exception of winter solstice sunrise.

## The Properties of Juxtaposition, Mimesis and Reversal at Sarsen Stonehenge

From this critique we have found that far from the southern minor lunar standstill moonsets being 'minor', or of 'no particular' interest, or opaquely 'miraculous', their pairing with the winter sunset at sarsen Stonehenge reveals a suite of characteristics that can be explained by a religious logic of estrangement. The choice of this particular juxtaposition allowed placing the moon in superior juxtaposition to the sun so retaining the priority that, arguably, Palaeolithic and Mesolithic hunting cultures conferred on the moon. The onset of ritual power with the period of dark moon is preserved and amplified by combining the southern minor standstill moonsets with the setting winter solstice sunset. This not only generates the longest darkest night possible, but by bracketing this dark moon with the setting winter sun, each mimics the other in their properties of signalling the onset of darkness. And by abstracting one dark moon from the twelve others in any one year, winter solstice provides the annual anchor for estranging ritual from a monthly to an annual cycle. Further, by creating the illusion from the Heel Stone that both moon and sun descended from the world above to the world below through the centre of the sarsen monument, it is constructed as an 'axial centre of the cosmos'. Earlier hunter-gatherer conceptions of a generalised sacred landscape were undermined by such artifice. More artifice is created when processing uphill in the final Avenue approach towards a descending winter sun – the two movements cancel each other and give the appearance of a momentarily frozen sunset. Ritual leaders, through prolonging winter sunset, demonstrated the power to 'stop time'. These properties were seen from the right hand side of the Heel Stone, bracketed with left hand side viewing of the southern standstill moon. This 'handedness' suggests a solar symbolism invested with concepts of male power (Hertz 1960). Now, instead of the week-long observance every evening of the setting sun in the lower window of the grand trilithon, within the upper window over a minor

standstill year can be seen the complex property of an abstracted, annualised and reversed set of lunar phases culminating at winter solstice with dark moon. Considered as signals, the right hand view of the sun is redundant while the left hand view of the moon is cryptic. This further suggests specialist knowledge of the lunistice moon is the preserve of some high ranking group. Techniques of juxtaposition, mimicry and reversal conflate rather than conjugate the horizon alignments of the moon and the sun.

None of this can be explained by a purely solarist interpretation for a main alignment on sunset. We would expect a sun-cult to begin at sunrise rather than at sunset<sup>48</sup>. It would also be problematical to posit a strictly *astronomical* explanation for a Stonehenge double alignment on an invisible moon within a disappearing sun. Rather than a solar or astronomical function for soli-lunar alignments at sarsen Stonehenge<sup>49</sup>, it is suggested that both incongruities disclose a religious substitution to mimic and estrange Palaeolithic hunters' lunar motifs into an emerging Mesolithic and Neolithic solar cosmology. There are good reasons to suspect that this cosmological conflation had been sought long before sarsen Stonehenge, and continued to be sought by other regional groups throughout the Neolithic and early Bronze Age (North 1996; Ruggles 1999; Burl 1981). Viewed this way, the lintelled architecture of sarsen Stonehenge is an elaboration of the same cosmological system of the earliest building phase of the monument, of the nearby and contemporaneous Avebury stone circle, and five other regional groups of monuments. All of these monuments are designed to entrain winter sunset with dark moon. This

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<sup>48</sup> See Hoskin's (2001) for a different view.

<sup>49</sup> "In some respects "megalithic" astronomy does not fit the simple model of an agricultural calendar. Lunar observations are only imperfectly related to the passage of the seasons and seem more related to lunar rituals than to the keeping of a calendar. The solar alignments indicate equal artificial divisions of the year rather than the irregularly spaced, natural times of agricultural activities...[C]eremonial...sites where astronomical alignments marked these regular divisions of the year suggests a more complex interaction of astronomy, society, ritual, and trade than that of a simple farmers' calendar." (McCluskey 1998b, 14)

strengthens the initial hypothesis made for sarsen Stonehenge, and it may prove a useful model to interpret paired alignments found more widely<sup>50</sup>.

## Conclusion

Ruggles has argued that the future of archaeoastronomy lies in adopting an anthropological approach to the astronomies of past cultures (Ruggles 2000a). Archaeologists have found ethnographically informed concepts of death and resurrection useful in interpreting many late Neolithic and early Bronze Age monuments. Sarsen Stonehenge, with its solar and lunar alignments, is located within a cremation cemetery (Burl 1981; Burl 1987; Burl 1994; Castleden 1993; Cleal 1995; North 1996; Pollard 2001). The new models in archaeology, anthropology and archaeoastronomy suggest that Neolithic rituals would have been constrained by earlier conceptions of sacred power ultimately derived from Palaeolithic hunter-gatherer cultures. In embracing and adapting this ancient rule to the logic of North West European pastoralists at least 4-5 thousand years after optimum conditions for big-game hunters, a strictly lunar time-scheduling to ritual could be reduced and estranged into solar cycles at lunar standstills whilst still preserving many properties associated with the synodic month. Seen this way, ancestor rituals beginning with winter sunset at dark moon might well have been timed to end with winter sunrise and possibly new moon<sup>51</sup>. Dark moon seclusion in the world below may have been conceptualised as temporary or transitional when, paired with the winter sunrise and new moon that follow, horizon alignments provide a venerable vocabulary of allusions of transformation. Such an arrangement retains the ancient Palaeolithic priority for ritual potency to coincide with dark moon suggested by sex strike theory.

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<sup>50</sup> For example, this model would predict that any double main alignments at wooden monuments would be on summer sunset and northern standstill moonsets.

<sup>51</sup> North suggests that an alignment on winter sunrise threads through another gap at sarsen Stonehenge at right angles to the winter sunset main alignment (North 1996, 425).

This is consistent with other researcher's suggestions that some Neolithic monuments were designed to be the points of intersection for the conceptualised worlds below *and above* the surface world (Barrett 1994; Bender 1992; Bradley 1998a; Edmonds 1999; Richards 1996b; Sims 2001; Tilley 1994; Tilley 1999). Ancestor rituals at these monuments may have manipulated astronomical alignments to bring these 'worlds' into conjunction with the processed remains of selected individuals to signify their 'transformation'. These hypotheses fit the known archaeology of Neolithic ancestor rituals, pit burials and votive deposits (Thomas 1999; Whittle 1996) and the anthropology of dark/new moon seclusion rituals providing the metaphors of death and rebirth (Knight 1991).

This article suggests that a reversal of an earlier forager communalism would be reflected in a Neolithic symbolic repertoire that used techniques of ambiguity and deception in monument design. It is in this context that we can interpret the conflation and confiscation of lunar properties within solar cycles at sarsen Stonehenge. Unlike some earlier models in archaeoastronomy, this rigorously 'religionist' interpretation requires no prior assumption of a Neolithic 'scientific' priesthood, yet also offers a motive for high fidelity alignments in some Neolithic monuments. Models drawn from archaeology, archaeoastronomy and anthropology independently point to a convergent interpretation in which soli-lunar settings and risings govern the rhythms of some burial and wider ritual practices. This is in marked contrast to claims for a sarsen Stonehenge summer solstice sunrise alignment, which remains an aberrant finding in archaeoastronomy, and finds little purchase in archaeological models of Neolithic burial practices.

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**Sims, L.D. (2007), 'What is a lunar standstill? Problems of accuracy and validity in the Thom paradigm.' *Mediterranean Archaeology & Archaeometry* 6:3, 157-163.**

## **What is a lunar standstill? Problems of accuracy and validity in ‘the Thom paradigm’.**

### **Abstract**

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North West European late Neolithic and Early Bronze Age (EBA) monumental alignments on the sun’s solstices and the moon’s standstills were first systematically studied by Thom (Thom 1971). Later research, since labelled ‘the Thom paradigm’ (Ruggles 1999), has rejected Thom’s eclipse prediction and calendrical theories for these ancient alignments, yet retained his definition of a lunar standstill as the ‘geocentric extreme declination’ of the moon (Heggie 1981a, Heggie 1981b, Hoskin 2001, Morrison 1980, North 1996, Ruggles 1999, Thom 1971). Thom suggested that prehistoric ‘extrapolation devices’ calculated this mid-transit property of the moon from observed horizon alignments, but subsequent research has found no evidence for such devices. While a mid-transit definition of a lunar standstill is an accurate specification of the phenomena, it is based upon the premises of modern heliocentric astronomy and is unlikely to provide valid interpretations of the monument builder’s use of *horizon* ‘astronomy’. This paper attempts to demonstrate that the current theories used to explain the late Neolithic/EBA function of lunar standstill alignments do not fit the horizon, and therefore megalithic user, properties of lunar standstills. It is argued that a recent model (Sims 2006b) is more consistent with the archaeology and ‘astronomy’ of horizon-aligned monuments, and with any ethnographic elaboration of the Thom paradigm.

### **Validity problems from defining a lunar standstill by its geocentric extreme declination**

Lunar standstills are defined within archaeoastronomy by the declination measure of the moon’s geocentric extremes (Heggie 1981b, North 1996, Ruggles 1999, Thom 1971). It is assumed that a series of corrections and adjustments must be made to this geocentric ‘essence’ (mainly parallax and refraction) to then translate the horizon properties of lunar standstills. While this is understood to be an ethnocentric assumption (Heggie 1981b, Ruggles 1999), there are few attempts to translate this definition into the framework of a late Neolithic/EBA *horizon* ‘astronomy’ which cannot have had any concept of a geocentric extreme. ‘[Geocentric extreme declination measures] ...is not the framework which would suggest itself most readily to a naked-eye megalithic observer, who would presumably

adopt a framework based on the horizon.’ (Heggie 1981b, 88). Thom’s suggestions that these alignments, coupled with ‘elaboration devices’, acted as either accurate lunar-solar calendars or eclipse prediction ‘computers’ have been discounted by later research (Ruggles 1999). The discipline now finds itself using a definition of a lunar standstill with little interpretive ‘framework’, and faces the danger of ‘paradigm fatigue’. However, with the rejection of earlier theories of a ‘scientific priesthood’ (Wood 1980), a turn to exploring the ethnographic dimensions of prehistoric horizon ‘astronomy’ and the recent receptiveness of archaeology to scholarly inputs from archaeoastronomy opens promising avenues for future research. Archaeoastronomy’s definitional crisis coincides with an inter-disciplinary opportunity.

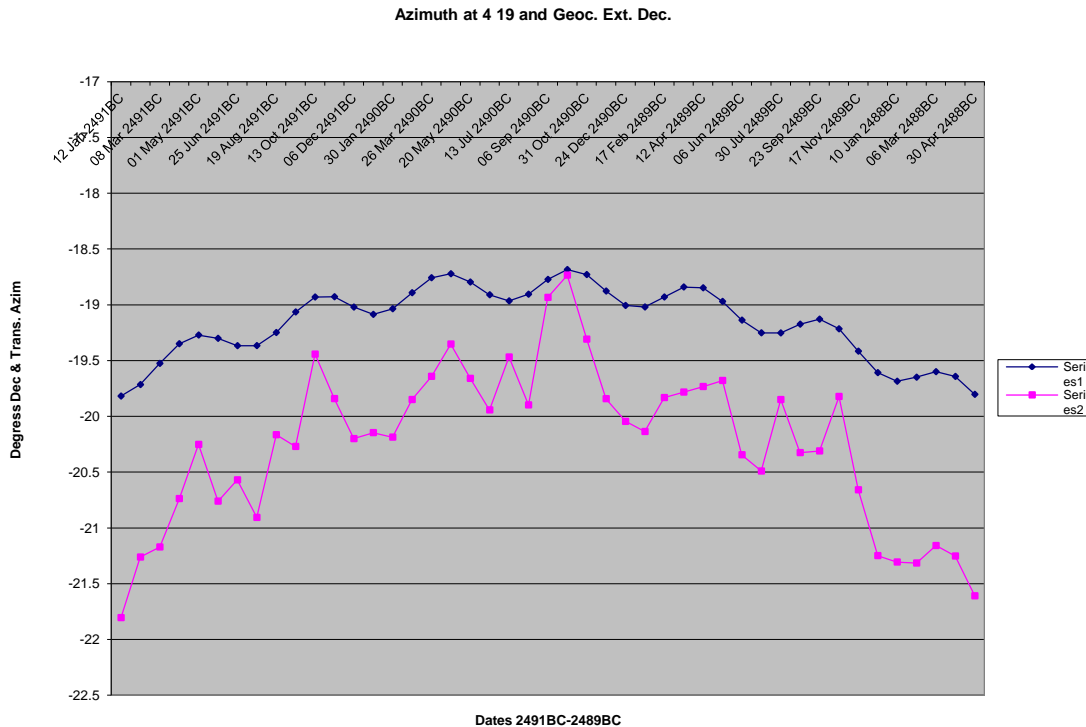
Two interpretations have been made for the horizon lunar alignments of ancient monuments: the ‘magical’ sinusoidal alternation of the foreshortened range of southern minor standstill moonsets (North 1996), and synchronising full moon with solstices (Ruggles 1999). Twice every nineteen years at the major and minor standstills, for a period of a year, the moon’s monthly horizon alternations between its southern and northern extremes return to the ‘same’ horizon positions. Between these periods the horizon range of the moon’s setting and rising positions move between its major and minor standstill limits which, at the latitude of Stonehenge is about  $10^\circ$  of azimuth outside and 9-10 years later about  $10^\circ$  of azimuth within the sun’s solstice horizon extremes. During the year of a standstill, when the moon is at its geocentric extreme, it exhibits a small monthly perturbation of the order of  $6'$  of declination which, over the course of a standstill year, describe a regular sinusoidal alternation and reverse scrolling through all lunar phases systematically meshing with solstices and equinoxes (Morrison 1980, Sims 2006b). It is North’s contention that at the southern minor standstill moonsets, this monthly perturbation can be seen in the grand trilithon upper window when viewing sarsen Stonehenge from the Heel Stone (North 1996, Sims 2006b), and it is Ruggles’s view that the synchrony of lunar geocentric perturbations with solstices allowed the monument builders to time their rituals with full moon at the solstices (Ruggles 1999). Both of these interpretations will be tested for their consistency with the horizon properties of lunar alignments.



## Lunar 'geocentric' standstills versus 'azimuth' standstills

The modern method to calculate the moon's position uses the single measure of declination – the number of degrees above or below the celestial equator. Since this measure assumes observations from the centre of the earth to the centre of the lunar disc, and since the moon is 'close' to earth, a 'parallax' correction must be made to adjust for observation from a specified position on the surface of the earth. But this method uses point estimate formulae drawn from modern astronomical spherical geometry, and this is not the only correction that must be made for interpreting prehistoric horizon 'astronomy'. During a standstill the moon's geocentric extremes occur when the moon is in *mid-transit*, not at the moment when it meets the horizon. Because the time between these moments of monthly geocentric extremes and the moments it meets the horizon are not regular, and because the moon is always changing its declination in the sky, another correction must be made which recalculates the new declination of the moon by the time it has reached a local horizon and then convert it to an azimuth value. This always modifies the pattern of geocentric extremes such that their mid-transit sinusoidal perturbations are not reproduced on the horizon. This can be seen in Figure 1, which is for the southern minor standstill of 2490BC at the latitude of Stonehenge. According to North the regular sinusoidal wave in the geocentric declination extreme would be seen as a horizontal zig-zag in moonsets in the grand trilithon upper window of sarsen Stonehenge (North 1996, 474-5). But when we calculate the horizon azimuths at moonset on the same days/nights as the geocentric extremes, we can see that the second series of azimuths (transformed to fit the declination scale) do not display any regular quarterly wave-line alternation. This difference between a lunar standstill at its geocentric extreme and at its horizon azimuth is true for all standstills. North's failure to translate lunar standstill geocentric extreme declinations to horizon setting azimuths leads him to make a claim for a lunar property that cannot be observed in the upper window of the Stonehenge grand trilithon (Sims 2006b). While the change in declination of the geocentric extremes are of the order of 6' of declination every month, the *horizon* azimuth oscillations of moonsets are on average double this value every month. This poses the problem as to what level of accuracy late Neolithic/EBA monument builders were able to track *any* oscillations in lunar or solar horizon extremes?

Figure 1 Geocentric extreme declination and horizon azimuth (transformed) at  $4^{\circ} 19'$  for the southern minor standstill moonsets for 2491-88BC at Stonehenge.



Note

1. All calculations made from SkyMap for Stonehenge location 2490BC.
2. Point estimates made to centre of lunar disc.
3. Geocentric extreme declination occurs in the moon's mid-transit.
4. The moon's horizon movements are measured by azimuth at an altitude of  $4^{\circ} 19'$ , the estimated height of the grand trilithon upper window.
5. The azimuth's for the moon's horizon movements has been transformed to fit the declination scale.

## Problems of accuracy in horizon 'astronomy'

Horizon 'astronomy' has to contend, knowingly or not, with refraction effects which increase exponentially the closer any view is made of an object to its rise/set horizon position. At an apparent altitude of  $5^{\circ}$  over an air mass the temperature of melting ice, refraction errors to altitude amount to  $10'$  of arc, whereas at sea level ( $0^{\circ}$ ) refraction effects rise to  $35'$ . Since these are errors to altitude, at the latitude of Stonehenge the *azimuth* errors would be approximately twice as great. Schaefer has shown that temperature inversions are ubiquitous and significantly raise these refraction errors for alignments close to the horizon (Schaefer 1989, Schaefer 1993). Reijs concludes that, taking these effects into consideration, it is best to assume alignments in Neolithic time were accurate to within 1 degree (Reijs 2001). Very similar estimates are provided by the U.S. Naval Observatory Celestial Navigation Data and by Sampson (Observatory 2003, Sampson 2003). Sinclair

and Sofaer have estimated the combined effects on azimuth alignment errors of parallax, refraction, and missed observations and estimate them to be in the region of  $\frac{1}{2}^{\circ}$  for solstices and  $1^{\circ}$  for standstills (Sinclair & Sofaer 1993). Reijs has also shown that for the major standstill year of 2006, taking into account  $0.3^{\circ}$  errors for refraction, then the point of the major standstill cannot be distinguished from 4 or 5 dates for azimuth extremes during 2006, none of which coincide with the actual date of the geocentric extreme. He concludes that we must assume that naked eye horizon astronomy cannot distinguish any observable differences in standstill horizon limits during course of the standstill year (Reijs 2003). In summary estimates of refraction errors for horizon alignments range from  $0.3^{\circ}$ - $1^{\circ}$  and we will assume for this paper a general alignment refraction error of  $0.5^{\circ}$ . How will this affect naked eye horizon alignments on the sun's solstices and the moon's standstills?

Assuming that refraction errors allow an accuracy of alignments no greater than about  $\frac{1}{2}^{\circ}$  disallows naked eye observers detecting any movement of the winter or summer sun for about 7 days before or after the solstice (SkyMap at Stonehenge latitude circa 2500BC). Similarly, over the course of a standstill year, more than half of all lunistice azimuths fall within a band of  $\frac{1}{2}^{\circ}$ , therefore also disallowing any one lunistice alignment taking precedence over the course of a standstill. The only quantitative property that horizon 'astronomy' can ascertain in a lunar standstill is therefore a horizon standstill position to within a degree or so upon which moonrises and moonsets hover. It remains for research to discover what qualitative property was selected from these alignments upon which cultural meaning was constructed.

### **Full moon versus dark moon**

In over two decades of testing the Thom paradigm Ruggles has demonstrated that many monuments in prehistoric Britain and Ireland are aligned on lunar standstills and the sun's solstices, although not to the levels of accuracy claimed by Thom. Specifically, in five regional groups of late Neolithic/EBA monuments Ruggles has shown that these alignments are to the south-western quadrant of the horizon, therefore linking winter sunset with either the southern major or minor moonsets (Sims 2006a). Surprisingly Ruggles considers these pairing 'anomalous' (Ruggles 1999, 142,158), since when moon and sun are in the same horizon quadrant it will be dark moon, and this is not consistent

with his preferred interpretation that monument builders required full moon to phase-lock with their rituals.

There are good *a priori* reasons for questioning this judgement. First, during the course of a standstill year alignments on either the southern or northern lunistics will allow about nine lunistic moons to be observed setting or rising. These will scroll through the lunar phases associated with a synodic month, but now spread over the course of a year and in reverse order to monthly lunar phases (Sims 2006b). Full moon is just one of these nine possible alignments. If we claim that the monument builders were selecting full moon then some testable criteria must be identified to justify this selection. If a lunar alignment is considered separate from its pairing with a solstice alignment, then this claim is problematical since alignment differences less than half a degree are required to discriminate between full moon and any other lunistic moon during a standstill. As we have seen naked eye horizon astronomy cannot achieve these levels of accuracy. Second, the *double* alignments found by Ruggles combine alignments on the winter solstice sunset with the lunistic moonsets of the southern (major and minor) standstills. While this identifies a series of lunar alignments throughout a standstill year, when the winter solstice sunset joins this double alignment it conflates winter solstice sunset with dark moon – *not* full moon. To suggest that full moon was the builder's moon of choice therefore throws away archaeological evidence that many *stone* monuments main alignments are orientated to a pairing of the sun and moon to the south west. Ruggles choice of full moon ignores the evidence from the monuments' architecture which is a double alignment for both sun and moon to the south-west – not one to the south west for the sun and one to the north-west for the winter full moon. Third, Ruggles' preference for full moon leads to otherwise inexplicable findings in his field data, all of which are resolvable, not anomalous, by accepting that the builders wished to bracket winter solstice with dark moon (Ruggles 1999, 142, 158)). As a point of method, this was understood in an earlier re-examination of the Thom paradigm:

'There seems no good reason for supposing that phases other than full would have been unsuitable for observation. Nevertheless several writers put much emphasis on the full moon, and one often reads such phrases as 'the midwinter full moon' in some discussions of megalithic astronomy.' (Heggie 1981b: 98).

Fourth, of course a full moon (or dark moon) will always take place within one month from any solstice. Archaeoastronomy's job is to verify and interpret *alignments* on the sun, moon and other astral bodies. If Ruggles is referring to a *southern* standstill lunar alignment on full moon, then this occurs close to summer solstice not winter solstice, and is an alignment built into the monument's design. But if it is to the winter full moon (Ruggles 2006) then this takes place at the northern lunistice and ignores the main axial double alignments his data reveals. To further test this claim, if we can show that a winter full moon falls outside the  $\pm 7$  day winter solstice period observable by naked-eye horizon 'astronomy', then this will weaken the claim that prehistoric monument builders wished to synchronise their rituals with full moon. In Table 1 below it can be seen that for four standstills dark moon always occurs within seven days of a solstice when horizon astronomy would still be observing the same 'stationary' sun, whereas full moon occurs outside the two week solstice period. Interestingly this relationship is reversed for the inter-standstill years, during which full moons are closer to the day of the solstice compared to dark moons. Indeed if monument builders wanted to fix an alignment that would guarantee a full moon to synchronise with the sun's solstices there is much to recommend choosing a double alignment in an inter-standstill year rather than standstill year. The angular separation between the sun and the moon is small during an inter-standstill year, of the order of about 2 degrees of declination, and it would therefore be architecturally easier to bracket both in one paired alignment. Second the range of annual azimuth perturbation is greater than during a standstill (3 instead of 1-2 degrees), and therefore requires less accurate alignments in monument construction. And lastly eclipses group during the solstice period in an inter-standstill year, rather than during the equinoxes as in a standstill year.

Therefore, if the assumption is that prehistoric builders wanted to entrain their monuments on full moon, or on eclipses, or on both, or avoid dark moon, then an inter-standstill year would be the year of choice. To my knowledge, no such alignment has ever been found anywhere in the world. Instead the last forty years of research has found hundreds of double alignments on solstices and standstills for which the main alignments are on southern standstills (major and minor) which are bracketed in a relation of identity with winter solstice sun. This always conflates dark moons, not full moons, with winter solstice. For cultures that accord respect to lunar-phased rituals, such an alignment will not be compromised by a lunar eclipse, since eclipses cannot take place at solstices during standstills.

**Table 1**      **Number of days between nearest solstice and lunistice full and dark moons for selected standstills and inter-standstills** (SkyMap for Stonehenge location)

Year	Designation	Lunistice	Nearest Solstice	Number of days from Full moon Dark moon	
2508BC	Minor	Southern	Summer	10	
			Winter		2
		Northern	Summer		4
			Winter	12	
2499BC	Major	Southern	Summer	9	
			Winter		2
		Northern	Summer		5
			Winter	11	
2006AD	Major	Southern	Summer	9	
			Winter		1
		Northern	Summer		4
			Winter	12	
2014/5AD	Minor	Southern	Summer	9	
			Winter		1
		Northern	Summer		4
			Winter	12	
2495BC	Inter-standstill	Southern	Summer	5	
			Winter		11
		Northern	Summer		9
			Winter	2	
2010AD	Inter-standstill	Southern	Summer	4	
			Winter		5
		Northern	Summer		9
			Winter	0	

## Conclusion

Readers should be aware that a large body of ethnographic literature is consistent with these findings. In anthropology dark moon is not ‘new’ moon. Ethnographically, the arrival of first waxing crescent moon around sunset is culturally constructed as a (re)birth out of dark moon signified ‘death’. The most powerful ceremony of the Hadzabe – Epeme – must be timed with dark moon. These Tanzanian low latitude big game hunters represent this as the time that their ancestors come closest to them, and is the most propitious time to ritually guarantee successful hunting (Power 2005, Woodburn 1982). The Saami/Samek – high latitude reindeer herders – celebrate dark moon in winter as time of magical creation (Karsten 1955). And for the First Nation people of the American Plains, the ‘Sun’ dance was a defiant ritual against the mid-day summer sun and re-appropriation of ritual power within the pitch black (dark moon) initiand’s sweat-lodge (Knight 1987, Levi-Strauss 1978, Mails 1998). Marshak showed that the notches with the greatest emphasis on Palaeolithic

bone ‘calendar sticks’ were on dark moon (Marshak 1972). And the only neo-Darwinian theory of human origins which can also engage with cultural origins predicts that dark moon seclusion of matrilineal coalitions was an essential precondition for establishing the cultural domain (Knight 1995, Sims 2003). If this way of interpreting lunar standstills is robust, then it predicts that we will find not just a bracketing of solstice sunsets with standstill dark moons, but a wider syntax of ethnographic and other archaeological and ‘astronomical’ evidence associated with darkness, astral observation and waxing crescent new moonsets phase-locked with solstice alternation.

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# INTEGRATING ARCHAEOASTRONOMY WITH LANDSCAPE ARCHAEOLOGY: SILBURY HILL – A CASE STUDY

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**Abstract.** Weaknesses in both archaeoastronomy and landscape archaeology can be overcome by their combination. This is demonstrated through a new interpretation of Silbury Hill in Avebury, Wiltshire. If monuments in their local landscape are considered as one choice in a system of alternatives, tests can be devised to interpret the prehistoric builders' intentions. This exercise finds that the builders chose a prescriptive arrangement of views of Silbury Hill so arranged to simulate a facsimile of the moon entering and returning from the underworld.

**Key words:** Dark moon; crescent moon; Silbury Hill; West Kennet Avenue; Beckhampton Avenue; Avebury; underworld.

## 1. INTRODUCTION

Archaeoastronomy has to move on from the legacy of the Thom paradigm if it is to prove its relevance to science (Sims 2006). Over the last three decades the discipline has established robust field methods procedures and, in so doing, falsified Thom's claim for a prehistoric precision astronomy (Thom, Ruggles, Hoskin, Belmonte, Schaefer, North). It is now standard fare for archaeoastronomers to demonstrate whether ancient monuments have non-random alignments on the sun's solstices, the moon's standstills or astral alignments, all accurate at best to one-third of one degree. The question is: so what? Is it to be left to other disciplines like archaeology and anthropology to then interpret the meaning of such alignments (see Lankford 2007, 1-19)? This paper suggests that an interdisciplinary approach could achieve the breakthroughs that have so far eluded archaeology.

## 2. SILBURY HILL

### *2.1 The archaeology of Silbury Hill*

Silbury Hill (SH), one part of the Avebury monument complex in Wiltshire, England, is the largest prehistoric man-made mound in Europe. It is 37 metres high and designed in the shape of a regular truncated cone with a level circular summit platform. To date, no convincing explanation as to its meaning has been offered. Archaeologists have long expected that excavating the interior of the hill would reveal burials or deposited artefacts that would provide the clues to its decoding. In spite of the many tunnels that have been dug, so much so that the Hill has now to be rescued from imminent collapse, no burials have been found nor interpretive breakthroughs made. Barrett suggested that SH, seen from other structures in the Avebury monument complex, is an elevated platform upon which a select few can observe and be observed (Barrett 1994, 31). This would not explain why steps cut into the chalk from the causeway entrance travel *down* into the seasonal moat, rather than up to the summit platform. Whittle makes a similar suggestion for viewing from the SH summit over the stockade and into the nearby West Kennet Palisade Enclosure (2007). However, both suggestions beg the question of why the Hill was built in the *lowest* part of the local landscape, or why some smaller structure might not have been built on the top of the equally high and adjacent Waden Hill.

## 2.2 *The archaeoastronomy of Silbury Hill*

Three different claims have been made for the astronomy of SH, all of which are found wanting by modern archaeoastronomical methods. Dames suggested that the west-east axial alignment Venus figurine shaped moat surrounding SH provided an agricultural calendar when, at the equinoxes, the sun and moon alternately rose and set from her moat vulva and into her moat head. Dames further claims that a summer sunrise and winter sunset line doubled for the mid-winter and mid-summer mid-swing full moonrises and moonsets at inter-standstill years, and traced a line of azimuth through the base of the figurines spine towards the womb-head (Dames 1976, 117-176). All of these claims are made to fit a plan diagram which conflates a viewing platform at 187 metres above sea level with a moat level at 149 metres beyond to distant horizons with no contemporary foresights. While lines on a plan diagram may be made to intersect anthropomorphic qualities invested in a watery figurine, no such line exists for an observer nearly 40 metres above the level of the winter fosse which surrounds SH. All of these claims are better explained as the *post festum* findings of a problematical mother-goddess model. North

(1996) has suggested that from the base and final summit of SH, astral alignments on the risings of Sirius and Rigel respectively would have been seen over the nearby East Kennet Long Mound. This may be so, but then SH is surrounded by one of the greatest concentrations of mid-Neolithic long mounds and Early Bronze Age burial mounds in the world, and it would not be a surprise if just one of them could be found by chance to have a horizon alignment from SH on a single asterism. Lastly, Devereux (1991) has claimed that the terrace feature 4-5 metres below the level of the summit platform allowed a repeat viewing of summer solstice sunrise over the adjacent Waden Hill. But since the terrace is most elaborated to the north of the summit surround, not to the north-east, and since no markers exist either as backsight on SH or as foresight on Waden Hill, then it is simpler to assume that the terrace had some other function. Beside these three claims, archaeoastronomy has not been able to find any significant solar or lunar alignment upon SH from any of the three main circular enclosures that make up the monunent complex (West Kennet Palisades, the Sanctuary or the Avebury Circle).

### *2.3 The landscape archaeology of Silbury Hill*

Neither archaeology nor archaeoastronomy have so far not succeeded in interpreting SH. It offers a further paradox - it is placed roughly in the middle of a monument complex from which views of SH are intermittently obscured by intervening hills (Fig. 1). It's location is especially curious when considered against the landscape just north of the Avebury circle, which offers an almost perfectly level plain, and which leads to the flanks of the ancient venerated site of the Windmill Hill causewayed enclosure. Central place theory would predict that this would be an ideal location for a an elevated viewing platform, upon which local ritual specialists could out-pomp visitors from the nearby Marden, Stonehenge and other monument complexes. If we put this paradoxical property at the centre of our inquiry this constrains both archaeoastronomy and landscape archaeology to operate on a higher level than when each is used in isolation.

Archaeoastronomy has mainly adopted a statistical approach in dealing with the problem of intentionality – are alignments in prehistoric structures random or by design? By aggregating regional groups of monuments with identical design, and using rigorous scaling procedures for identifying sightlines, the distribution of deviations from these grouped alignments against randomly generated lines of sight provides statistical tests to

guard against the over-interpretation common to the discipline in the 60's and early 70's. This methodology has established that not only did five regional groups of monuments in late Neolithic and Early Bronze Age British Isles have solar and lunar alignments, albeit at levels of precision of at best one-third of one degree rather than Thom's claim of one second of arc, but that 332 of them had paired alignments which bracketed the winter solstice sun with the southern standstill moons (Ruggles 1999). However, this method cannot begin to deal with the unique and outstanding monuments that represent the culmination of this megalith building culture, like Newgrange in Ireland, and Avebury and Stonehenge in Wiltshire, each of which are one of a kind. Landscape archaeology, on the contrary, specialises in studying in great detail the landscape context of an individual monument in their intimate association. The work of Tilley, in particular, sensitises us to the embodied experience of walking around and through the monuments, and how this experience is subtly manipulated by views and perceptions which are modified by our landscape location as we move through it (Tilley 1994). However, unlike in archaeoastronomy, which has developed rigorous selection criteria for what can and can't be admitted as data, Tilley's phenomenological approach has been severely criticised for "...a version of landscape archaeology which is much more dependent on rhetoric, speculation, argument by assertion, and observation not always replicable when checked" (Flemming 2005, 930). If we can devise a method that combines the particularity of Tilley's landscape archaeology, but combines it with the rigour of robust selection criteria now standard in archaeoastronomy, then the combined methodology should assist a deeper decoding of unique monuments like SH.

The Avebury monument complex in particular assists such an enterprise, since it prescribes through its two avenues of parallel rows of stones (West Kennet Avenue and Beckhampton Avenue, marked at 3 & 5 respectively in Fig. 1) the ritual routes processionists would have travelled in the late Neolithic and Early Bronze Age. But to guard against the limited interpretations these actually chosen routes might suggest to our subjective experience, we can consider the landscape as a region of variability, in which many other opportunities were simultaneously available, but actually not taken by the monument builders. For this procedure, we assume that the level of technological expertise, amount of labour power available, architectural design, landscape and, in this case, Avebury Circle, are all held constant. We introduce variability by considering all of the logical possible alternative routes for the two Avenues and location for SH which would

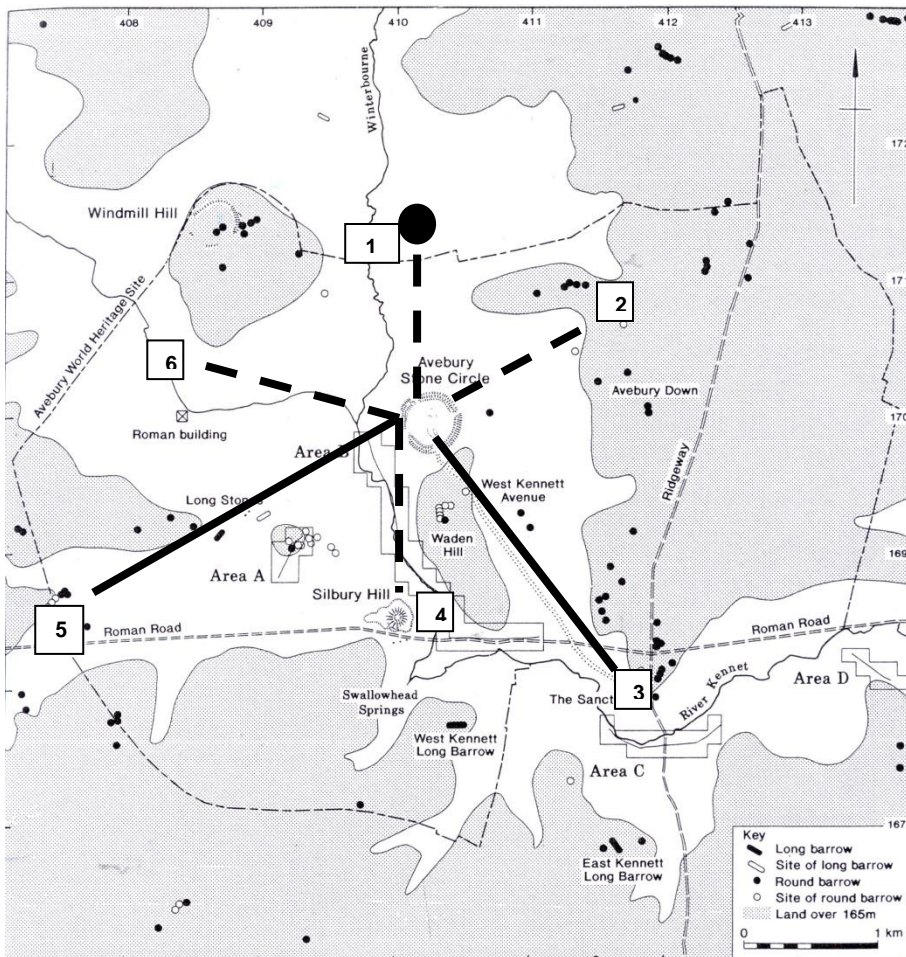
exhaust the properties of the local landscape which participants could embody. This is not an arbitrary procedure. For example, it is not the case that there could be as many alternative Avenues as degrees to a circle emanating from Avebury Circle. We choose only, but all, of those alternative routes that offer a *qualitatively* different aspect of SH when walking towards or away from Avebury circle. If this procedure is fruitful, then our expectation is that the chosen routes for the two avenues at Avebury were selected against all of the logical alternative routes precisely because they offered a suite of views required for the ritual practiced at this site. If we cannot find an over-arching explanation for this chosen portfolio of views then this exercise will have severely qualified the phenomenological approach in landscape archaeology.

### 3. *Landscape as a region of alternatives*

It can be shown (Sims forthcoming) that the chosen combination of Avenues offer more and systematically different views of SH compared to all other logically possible pairs of avenues, and for whether SH is located on the flat plain north of Avebury Circle (at end of avenue 1 in Fig. 1) or in its actual location near to the southern end of Waden Hill. This exercise reveals that the monument builders wanted a pair of avenues that skirted SH at a roughly constant distance, and for which for over 70% of their length all views of the hill were completely obscured by two intervening hills (Waden Hill and a ridge centred on Area A on Fig. 1). The builders would have had no difficulty in locating either SH or the avenues on the flat plain north of Avebury Circle, or to have routed the avenues directly towards or away from a SH built in either location. The only conclusion to be drawn is that the builders *intended* viewing SH not in analogue mode, in constant view and growing or diminishing in size with directly approaching avenues, but in digital mode as carefully selected views at a distance from five key positions in the monument complex separated by long sections of the Avenues in which all views were obscured. At the start of Beckhampton Avenue (5 in Fig. 1) SH can be seen with its summit platform protruding above the background eastern horizon; from where the Beckhampton Avenue crosses the River Winterbourne just to the west of the Avebury Circle, the level summit platform exactly coincides with the level of the background horizon to the south; from stone i of the D feature in the centre of the inner southern circle within Avebury Circle, looking to the south-south-west the cropped top of SH protrudes above Waden Hill; processing around the rest of the stones of the D feature, this cropped top gradually slips below the lip of Waden Hill; at the Obelisk stone, at the

apex of the D feature, and the largest stone in the Avebury complex, the top of SH is obscured by the large blocking stone 102 of the southern inner circle; and finally, from the Sanctuary the top of SH is again exactly in line with the background western horizon. These are the only seven views, from five positions, prescribed by the architecture of the late Neolithic and EBA Avebury complex. For the rest of their lengths SH cannot be seen from the Avenues.

**Figure 1 Avebury Complex with schematic Avenues, including other possible Avenues and SH location given (a) the position of Avebury circle and (b) landscape variation.**



Adapted from Powell (1996: 11)

#### 4. *Integrating archaeoastronomy and the phenomenology of landscape*

Davies and Robb (2004) have suggested that behind the many limited references archaeologists have made to an underworld lies a theme of more general applicability. They demonstrate that features such as caves, rock fissures, sink holes, flint mines, shafts, tree-throw hollows, ditches, pits, springs, bogs, rivers, lakes and post and stone holes have been interpreted as portals to the underworld. In their exploration of archaeologist's under-interpretation of this verticality dimension, that show that many of these features, and others such as burial mounds and ditch banks, can be seen as designed as if they were being viewed from the underworld. Surprisingly they do not extend the dimension of verticality to the above world. Most of the astronomical alignments found by modern archaeoastronomy are to the western horizon, on the settings of stars, moon and sun (North 1996, Ruggles 1999). This is counter-intuitive to the expectation of observational astronomy, but entirely consistent with the religious requirement to mark the horizon portals to the underworld. Extending this insight to the seven prescribed views of SH seen from the Avenues and southern inner circle at Avebury, there is only one empirical entity that fits the condition of a chalk white crescent scarp that to the east is proud of the horizon, to the south and west is level with the horizon, and from the Avebury circle both sinks on the south-south-west horizon and is occulted by a blocking stone. That entity is the moon in its waning crescent before sunrise, its dark moon occultation, and its waxing crescent sets – namely those phases before, during and after dark moon. Since the Avebury circle has been shown by North (1996) to have a paired alignment on the winter solstice sunset and the southern major moonset and Ruggles has shown that the same combination of alignments can be found at over 332 other stone structures of the period (Ruggles 1999), and as this combination always generates dark moon at winter solstice (Sims 2006, 2007), then this is a consistent extension of verticality to the concept of the underworld from the addition of archaeoastronomy to landscape archaeology.

One final comment needs to be made. Davies and Robb imply that monument structures can be visualised as membranes not just *to* the underworld, but *from* the underworld. The specific design properties of a monument might then best be perceived as if it were being viewed *from* the underworld. We can extend this insight when we consider the seven views prescribed by the Avenue routes and Avebury Circle. If our hypothesis that the scraped clean chalk wall of the upper terrace on SH is a representation



of the crescent moon, and if from two places along the Avenues we see this crescent of chalk to be level with the background horizon – then we are witnesses to a moon that has just set and is in the underground. More than that, if we as ritual participants can observe the moon in the underworld, then this representation immediately places us along with the moon in the underworld. It shifts us from this world to the underworld. Seen this way, one function of the Avebury monument complex is to simulate a journey into, through and back from the underworld.

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## **Entering, and returning from, the underworld: reconstituting Silbury Hill by combining a quantified landscape phenomenology with archaeoastronomy.**

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Landscape phenomenology limits the number of possible narratives for interpreting prehistoric monuments through the embodied experience of walking their remains in their landscape. While this method may improve upon an archaeology that narrows interpretation to single site excavations isolated in euclidian space, it has been criticized for deploying unsubstantiated metaphors as an interpretive resource. Contemporary archaeoastronomy's dominant methodology submits regional groups of prehistoric monuments to rigorous statistical methods for testing whether perceived alignments were in fact intended by their builders. However, it is presently unable to saturate alignment findings with meaning, and reaches its limits when monuments are found to align on local landscape features rather than 'astronomical' bodies. Through a detailed examination of Silbury Hill in its landscape and late Neolithic/EBA monument context this article shows that problems in both methods can be transcended by studying the emergent properties generated by their combination. These emergent properties are consistent with the predictions of a recent anthropological model of lunar-solar conflation.

### **Phenomenological approaches to landscape**

Post-processualist concepts of space and place require 'thinking through the body' (Johnson 1999: 114). The embodied accumulation of sensory and purposive experiences in space over time builds an accretion of memories into a sense of place. These small scale visual, haptic and kinaesthetic spatial experiences construct a 'topophilia' sensibility of and for a familiar locality (Tuan 1974, 1977). This conscious bodily experience in everyday life mediates inner perception and the external material world and is a potential resource for archaeologists walking through monument remains in their landscape. The monuments of the late Neolithic and Early Bronze Age (EBA) in their local landscape differentiate and categorize space, and the particular combinations of up/down, left/right, wet/dry, enclosed/open, on/off, wood/stone etc. for each prescribed route in monumental space inscribes a particular suite of experiences through the body. Their complex architecture positions and orientates the body and produces a limited range

of sensibilities, which we can re-experience today. Over the last two decades a number of archaeologists have proposed that this strategy allows them to make plausible interpretations of prehistoric rituals that might have been conducted there (Barrett 1994, Thomas 1996, 1999, Tilley 1994, 1999, 2004a, 2004b, Whittle 1996, Pollard et al. 2002, Tilley et al. 2000, Tilley et al. 2001). Instead of positing the operation of abstract rules or structural constraints, this approach seeks the 'bottom-up', rather than 'top-down', routines of everyday life through which active agents construct society (Johnson 1999: 105). According to such a view the cattle herders of the late Neolithic and EBA chose a semi-nomadic life-style with periodic feasts and rituals at their monuments, and this was their way of 'dwelling in the landscape' (Ingold 2000). Careful evaluation of the context and variable patterns of material culture associated with such embodied experience in the detailed arrangements of monument architecture allows these authors to construct middle-range theories of past rituals.

Yet no amount of bottom-up constructions of individual concrete experience can reach the collective representations of symbolic culture. This nominalism works at the level of the atomistic sensations of individuals, and cannot achieve the conceptual phase transition that reveals the emergent properties of a supervening system of cultural meaning (Hacking 1999). Tuan, for example, cannot explain the cultural-level properties of place - why Western architecture is oriented towards looking out into wide-open spaces compared to Eastern architecture, which looks inwards to elaborated courtyards (Tuan 1977, 124), or why in all cultures 'subjective space' compared to 'objective space' is conceptualised along a vertical as opposed to a horizontal axis (Tuan 1977, 120). These are cultural-level constructions that transcend individual-level, sensuous experience. Similarly, post-processual archaeology cannot explain the replication of monument designs across regional groups (Thomas 1996, 134; Tilley et al. 2001, 346). If the method is to build a fine grained set of discrete experiences for each monument in its particular landscape, then inter-regional patterns cannot be explained by such nominalist categories. Furthermore, while most of these authors now address some of the 'astronomical' properties of these monuments' horizon alignments, their method would find it difficult to explain why across seven regional groups of late Neolithic and EBA all stone monuments in the British Isles exhibit an identical 'astronomy' on the horizon settings of the winter solstice sun and the southern standstill moons (North 1996, Ruggles 1999, Sims 2006). These anomalies point

to 'top-down' processes which transcend individual-level, sensuous experience, and indicate unexplained structures of cultural meaning.

Recognizing this problem, Thomas argues the need to 'tack back and forth' between alternating nominalist and structural levels (Thomas 1996, 98). But while his method of comparative contextual examination of material culture is rigorous, he does not explain by what criteria he selects the elements of wind and water, for example, to interpret European-wide spiral and lozenge motifs in pottery, mobiliary artefacts and rock art. (Thomas 1996, 158-9). Tilley attempts to transcend this limitation by appropriating the structural-level concept of the 'underworld' to explain the cultural context which informs the monument builders' designs. His choice is drawn from Aboriginal, Cree and Tewa rituals, all of which place great emphasis on constructing features of their local landscape as portals to the underworld (e.g. Tilley 1994, 49-51, 54-55, 66; Tilley 1999, 238, Tilley et al. 2001, 336), but he also provides no justification for his ethnographic selection. Tilley is not alone in adopting this concept. Although not claiming to conduct an exhaustive survey, Davies et al. (2004) found that in publications between 1986 and 2002, 26 archaeologists of the British Neolithic and EBA also used the concept of the underworld to interpret ten different features: caves and fissures, sink holes, flint mines, shafts and wells, trees and tree-throw hollows, ditches and mounds, pits, post and stone holes, springs, bogs, rivers and lakes, and plough scatters. Yet no matter how appropriate this choice of term might be, it remains an *ad hoc* suggestion. Collective representations such as the 'underworld' have no empirical referent, and while some bodily sensations may be useful in constructing its imagining, they cannot constitute it in themselves. They are emergent, higher-level cultural categories that transcend individual level cognition or intention. The concept of the underworld must pre-exist the individual, already be part of the 'habitus', so that embodiment can selectively draw upon perceived properties of a walked-within place to be experienced in that way. We therefore need methods that can capture the cultural level representations of the monument builders.

This paper focuses on two aspects of this debate to suggest a way to transcend these problems – the validity of scientific testing, and the issue of conceptual scale appropriate to the level of interpretation. Post-processualists have critiqued the positivist assumption that when we collect data it is 'raw' and untainted by theoretical premises. But while we can accept that all theories and data collection are embedded within a socially constructed

political agenda, they are not all equally flawed. Some interpretations are better than others, and all authors so far mentioned discriminate between them by the methods of science. Tilley, for example, tests the hypothesis for intentional inter-visibility between burial mounds and prominent landscape features by considering other possible local sitings (Tilley 1994:150, 173). Thomas compares the actual siting of the Avebury monuments in their local landscape with the curious choice not to situate them on the level ground north of the present Avebury village (Thomas 1999, 217). Thus '[T]he processualist view will grant that everything we say is in some sense political, but by using science we can move away from just telling stories' (Johnson 1999: 173).

But no amount of phenomenology can make the conceptual leap from the nominalist level of everyday individual routines up to the structural level of collective representations. The most that can be achieved by nominalism is the inductive assumption that once all categories are aggregated, in their logical sum they culminate in a representation of the total world. This is a model of monumental place as the summation of overlapping combinations of material and features as a microcosmic representation of the whole world, miniaturized and centralized at the monumental 'axis mundi' (Thomas 1996, 233) or 'the world recreated' (Bayliss et al. 2007, 26). But cultural symbols, derived from social-structural level processes, are capable of constructing place as an anti-world, with properties that defy and undermine the accreted experience and memories of everyday routines. The concept of the underworld, widely attested to in anthropological literature and recently popular in archaeology, is constructed as a reality-defying systematic opposite to this world. The start of night in this world is the start of day in the underworld; all that is broken in this world is whole in the underworld; the cattle that have disappeared from this world have been stolen into the underworld; what moves from east to west in this world moves from west to east in the underworld, etc. (Eliade 1988, Jacobson-Widding 1991, Lincoln 1991, Sullivan 1988, Lattas 2006). Such power to dislodge the common sense meanings of sensory experience severely limits the explanatory power of post-processualism. But whether or not any part of prehistoric material culture was constructed as such an anti-world has to be demonstrated in each concrete case, no matter how compelling the concept may be to a variety of features. As a single nominalist methodology, post-processualism cannot extricate itself from this dilemma. But since the 'prehistoric' past is closed off to us for observation, we have no direct way by which we can justify why this or any other ethnographic analogy might be an appropriate one from

which to select useful interpretive categories (Fleming 1999, 2005, 2006; Sims 2001). If the reality we are trying to get at is at a higher conceptual scale than can be generated by phenomenology, and if we have no method that can immediately identify categories at the correct scale, then we have to reconstruct those categories by reconstituting the reality.

One way forward is to combine the phenomenology of a particular monument with another robust method, in this case archaeoastronomy,<sup>52</sup> that will address different properties of the same monument. It will be shown that while in isolation neither of these two methods can create symbolic-scale categories, the partial properties of each allow just one type of combination which displays fully symbolic emergent characteristics representative of the structural-level processes of the monument builder's culture. Such a multi-disciplinary methodology can reconstitute a reality which exists both through the individual agency of embodied experience emphasized by phenomenology, and on the social-structural level of collective representations aspired to but not substantiated by post-processualism. This is not triangulation by two separate methodologies that independently point to the same conclusion (Wylie 2002), but methodological transcendence (Calinicos 2006) through two derived data-sets that can only cohere in one way and which display an emergent property at a higher, ethnographic, scale of meaning.

### **Quantifying landscape phenomenology**

This paper is a multi-disciplinary case study of Silbury Hill in the Avebury monuments, and will suggest an interpretation of them which is consistent with a recent anthropological model of late Neolithic and EBA monuments in the British Isles (Sims 2006). It is suggested that through rigorous sampling, and with a less restricted definition of landscape which includes skyscape, we can transcend the nominalist barrier to structural interpretations current in post-processual archaeology. First, we need to systematically search for all the logically possible ways a monument complex could have been located in its local landscape. By comparing these against the actually chosen arrangement, we can test whether there emerges a suite of features not available in any other location. If such a portfolio of features is found, it is one part of the process in reconstructing the symbolic meaning of Silbury Hill. Second, in the last decade and in varying degrees, many

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<sup>52</sup> Another would be linguistics. See, for example, Anders, K. (2007), *Fire, Water, Heaven and Earth. Ritual practice and cosmology in ancient Scandinavia: An Indo-European perspective* (Stockholm: Riksantikvarieambeter).



archaeologists have come to accept that some ancient monuments were invested with 'astronomical' alignments (Tilley 1994,189; Thomas 1999,181). Since over the last three decades the discipline has been re-set on rigorous foundations, continued scepticism towards archaeoastronomy is now holding back scholarship (e.g. Fleming 2006). Aggregated data sets of regional *groups* of monuments have been subjected to statistical tests to isolate whether any alignments found were *intentional* rather than accidental (Heggie 1981, Hoskin 2001, Ruggles 1999, Belmonte et al. 2006). We can use archaeoastronomy to investigate whether the Avebury monuments have a distinctive suite of 'astronomical' characteristics. As long as a scholarly archaeoastronomy can substantiate a monument's engagement with the underworld transit of a cosmic body, then this can provide another methodology that can be used alongside landscape phenomenology. Using both in tandem we are in a position to work out all the logically possible ways the two data portfolios may be combined.

The recent consensus within British archaeology is that Neolithic monument builders were in part addressing memories of earlier cosmologies (Tilley 1994, Thomas 1999, Whittle 1996). A recent palaeo-anthropological model of cultural origins specifies, amongst other things, that dark, not full, moon was the default moment chosen to trigger the mobilization of ritual power (Knight 1991, 1996, Power 1999, Watts 2005, Knight et al. 1995). In keeping with and by extension of both models, I have argued that monuments such as Stonehenge preserved an ancient respect for dark moon while confiscating it for the novel purposes of a cattle-herder lunar-solar cosmology (Sims 2006, 2007). Since this model limits the number of possible interpretations, it sets a more precise and falsifiable test for the emergent properties of Silbury Hill. The claim of this paper is that a quantified landscape phenomenology, combined with archaeoastronomy, reveals previously un-noticed properties to Silbury Hill consistent with the concept of 'the underworld' and this model of lunar-solar conflation.

## **Silbury Hill**

Silbury Hill is a 37 metre high truncated cone chalk mound in the Avebury complex of late Neolithic/EBA monuments in Wiltshire, dated to 2400-2000BC (Bayliss et al. 2007). Excavations into the centre of the mound in 1776, 1849 and 1968 expected to find, in keeping with a sepulchral model, human burials and rich grave goods. Archaeologists

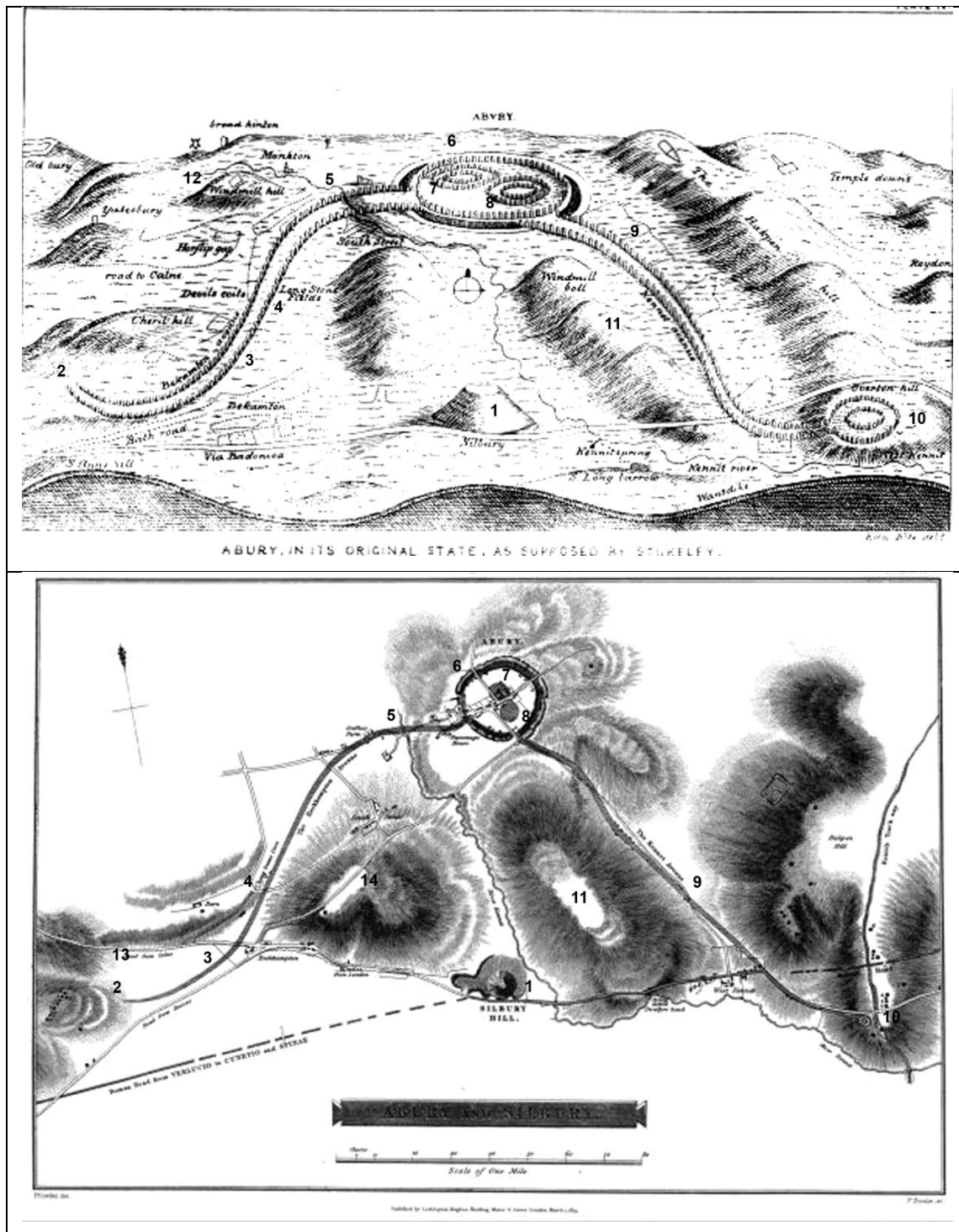
found no inhumations but instead that the builders possessed an impressive expertise in soil mechanics (Atkinson 1967, 1969, 1978, Burl 2002, Merewether 1851, Whittle 1997, Pollard et al. 2002). Another theory was that the top of the hill provided an elevated platform for ritual leaders to observe and/or be observed (Barrett 1994). But while the monument's summit almost equals the height of the adjacent Waden Hill, this hypothesis fails to explain why its location is in the lowest part of the surrounding Marlborough Downs, any higher part of which would have provided a magnificent site for such a superstructure. Alternatively, 'the low situation of Silbury Hill can only be due to the need to make a water fosse around it' (Flinders-Petrie in Watts 1993: 99), but then so would a number of other locations in the vicinity and this point in itself tells us nothing of the position, dimensions or form chosen for the hill. Doubtless the structure formed part of a 'ritual space' (Thomas 1999: 26), or may have marked a special location or portal 'to other spheres' (Pollard 2002: 120-1; Whittle 1997: 142-51), or might be a copy of Boyne valley passage graves or Egyptian pyramids (Whittle 1997:150), but these suggestions move the burden of interpretation backwards rather than forwards. In a new twist to the sepulchral theory, it has been suggested by Parker Pearson that sarsens found buried within Silbury Hill signify 'souls' (Parker Pearson 2000). While plausible, this hypothesis cannot explain the reason for their deposition within Silbury Hill, since similar stones are deposited along the West Kennet Avenue, the bedding trenches of the West Kennet Palisades and in the Sanctuary – all of which have widely different dimensions, materials and forms but share the practice of burying sarsens in their structure (Pitts 2001, Smith 1965, Whittle 1997). This review completes the archaeological interpretations so far offered for Silbury Hill.

Archaeoastronomy has made some inroads into unlocking the ritual content of some of the Avebury complex. Avebury circle has been shown by Burl (2002) and North (1996) to include alignments on the major standstills of the moon and the sun's solstices. As a way to guarantee that a mid-winter ritual will coincide with the longest night, and to bracket that ritual with a time when the moon is no longer in the sky, Avebury circle shares with sarsen Stonehenge and 322 other *stone* monuments the 'same' double alignment of identity (Fig. 4) on the winter sunsets and the southern standstill moonsets (Ruggles 1999, Burl 1981, North 1996, Sims 2006). However, the Avebury monument complex is more than the Avebury Circle, since it includes the Sanctuary, West Kennet Avenue, West Kennet Palisade Enclosures, Beckhampton Avenue, reworked portions of Windmill Hill and numerous EBA burial mounds largely on surrounding horizons (Fig. 1). The longer

chronology now preferred for the building of Silbury Hill is consistent with the interpretation that they were all in simultaneous use (Bayliss et al. 2007) and, except for the West Kennet Palisades, are all arranged in an approximate semi-circle to the north of Silbury Hill (Fig. 1). But the lunar-solar alignments from the Avebury Circle do not point to Silbury Hill. North suggested that from the Silbury Hill summit in the late Neolithic Rigel could be observed rising above the early Neolithic East Kennet long mound (North, 1996: 86). However, a round summit platform with only a vertical axis could be aligned on everything or nothing, so we must set this suggestion aside. An earlier attempt at the 'astronomy' of Silbury Hill had the merit of calling attention to a terrace, an original feature, just below the summit platform of Silbury Hill. It was suggested that viewing summer solstice sunrise to the north east over the crest of Waden Hill could be repeated by dropping down from the summit platform to this lower terrace some five metres or so below (Devereux 1991). It may be that to run a Neolithic replay of summer solstice sunrise made the structure twice as potent as summer sunrise at sarsen Stonehenge, but since Stonehenge never had a summer sunrise alignment perhaps the claim is twice as vulnerable to challenge (North 1996, Ruggles 1999, Sims 2006). If true this claim would suggest that the terrace would be most elaborated in the eastern half of the summit surround, but while it does not circle the summit equally it is most elaborated in its northern, not eastern, half. When archaeoastronomers find non-'astronomical' properties among monument complexes, such 'residuals' are normally consigned to unexplained 'landscape' features (Ruggles 1999).

Landscape phenomenology is particularly appropriate for a monument complex such as Avebury, which clearly prescribed a walk-through route in the two avenues that connected many of its constituent parts – West Kennet and Beckhampton Avenues. It has been suggested that 'Silbury Hill was perhaps a symbolic, tamed, or controlled, Windmill Hill' (Prior 2001: 89). Windmill Hill is a Neolithic 'type-site', a 'causewayed enclosure', built a millennium before Avebury. It is the only local isolated 'round' hill and, while it does not have a top terrace as does Silbury Hill, it did feature a series of ditches and embankments that encircled its summit, which the builders may have mimicked in their top terrace at Silbury Hill. This procedure of metaphor by assertion has been criticized (Fleming 2006). Unlike in archaeoastronomy, which has had to develop robust procedures to check that its findings are in fact data (Heggie 1981, Ruggles 1999), there is little transparency in this

Figure 1 Avebury complex in its landscape by (top) Stukeley 1724 (bottom) Crocker 1823 , with key to place-names mentioned in text.



#### Key

- |                    |                             |                          |   |                      |
|--------------------|-----------------------------|--------------------------|---|----------------------|
| 1. Silbury Hill    | 2. Fox's Covert             | 3. Beckhampton Avenue    | 4. Adam & Eve Stones and Longstones Enclosure | 5.                   |
| River Winterbourne | 6. Avebury circle and henge | 7. Northern inner circle | 8. Southern inner circle                      | 9.                   |
| Kennet Avenue      | 10. Sanctuary               | 11. Waden Hill           | 12. Windmill Hill                             | 13. Calne Road       |
|                    |                             |                          |   | 14. Beckhampton Road |

Adapted from Glastonbury 2001.

selection of Silbury Hill as a metaphor for Windmill Hill. If we can apply more robust sampling procedures, then both methods may gain by collaborating with the other.

### **Landscape as a region of alternatives**

If we are to re-experience the monuments in the way their builders intended, then the minimum requirement is to walk through them as prescribed by the two avenues.<sup>53</sup> But instead of taking just this *one* route and then opening ourselves up to the danger of looking for properties of the local landscape that confirm our assumptions for their choice, we could systematically explore all of the other possible routes that utilized all options offered by the locality using the same building skills and materials.<sup>54</sup> For this procedure we assume that the level of technological expertise, amount of labour power available, architectural design, landscape and, in this case, Avebury Circle, are all held constant. We introduce variability by considering all of the logical possible alternative routes for the two Avenues and alternative locations for Silbury Hill which would exhaust the properties of the local landscape. This is not an arbitrary procedure. We choose only, but all, of those alternative routes and Silbury Hill sitings that offer a *qualitatively* different aspect of Silbury Hill when walking towards or away from Avebury circle. If this procedure is fruitful, then our expectation is that the chosen routes for the two avenues and location for Silbury Hill at Avebury were selected against all of the logical alternatives precisely because they offered a unique suite of views required for rituals practised at this site. If we cannot find a unique portfolio of views, then this exercise will have failed this test.

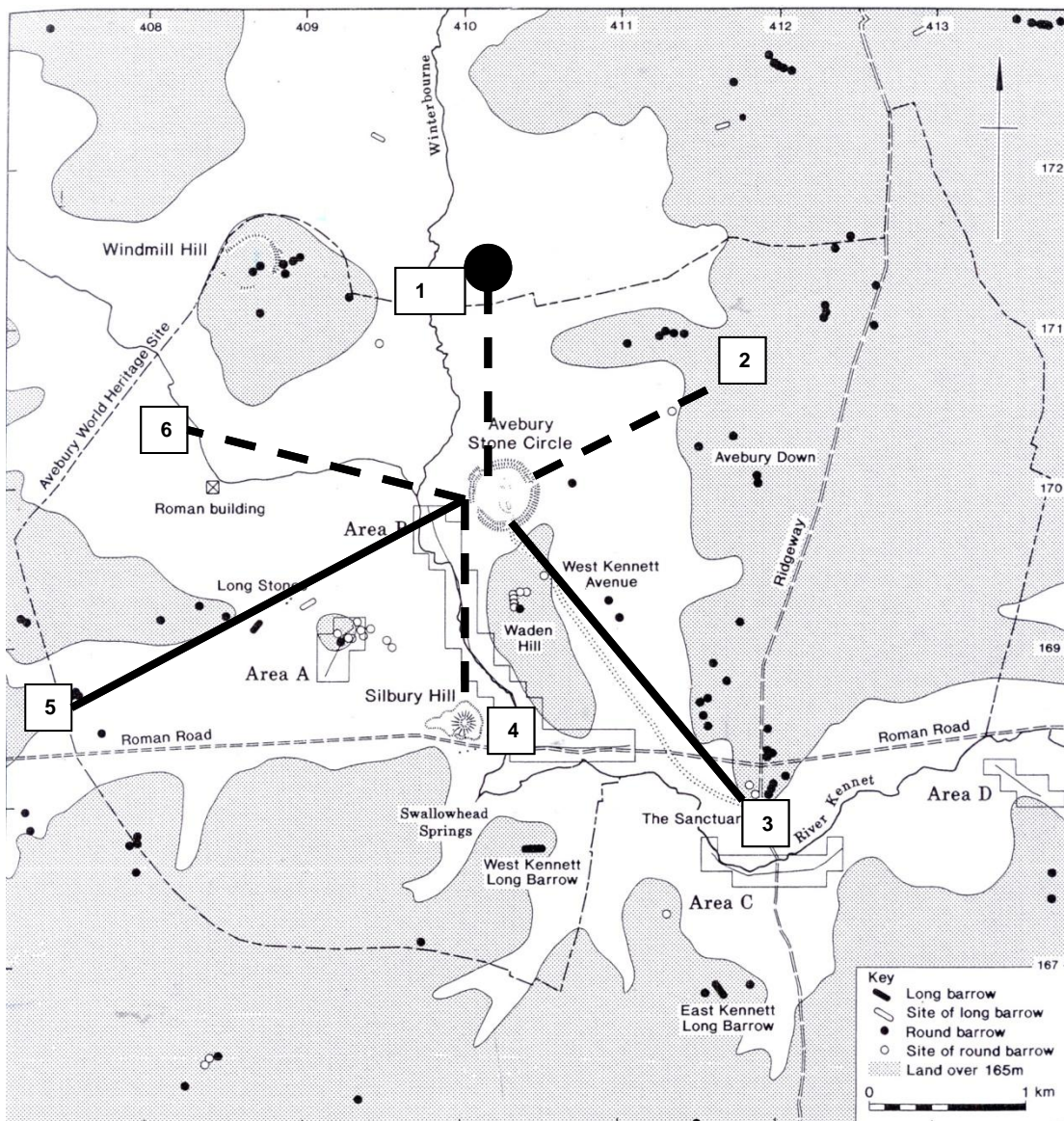
Keeping Avebury circle in its actual location, there are two main ways we can introduce variability. Figure 2 is a schematic rendition of the minimum number of possible avenue routes which logically exhaust the local landscape opportunities for viewing and the siting of Silbury Hill. Routes 3 and 5 represent the courses of West Kennet and Beckhampton Avenues, whereas routes 1, 2, 4 and 6 represent the minimum possible routes to Avebury circle's four entrances that draw on the local landscape contrasts. Our hypothesis is that any two of these six logically possible avenues could have been chosen, but that combination 3 & 5 was deemed by the builders to be the required combination. Out of the fifteen logically possible pairings, can we find any systematic difference between the

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<sup>53</sup> Contra Devereux (1991), who examines the views of Silbury Hill from East Kennet, Beckhampton and West Kennet Long Barrows – all built about a millennium before Silbury Hill.

<sup>54</sup> See Thomas (1999: 214-6) for a similar procedure.

**Figure 2 Avebury Complex with schematic Avenues, including other possible Avenues and Silbury Hill location given (a) the position of Avebury circle and (b) landscape variation.**



#### Key

3. West Kennet Avenue 'starting' at the Sanctuary.
5. Beckhampton Avenue 'starting' at Fox's Covert.
1. Logically possible avenue route, 'starting' at a possible alternative location for Silbury Hill, and 'ending' at the northern entrance of Avebury henge.
2. Logically possible avenue route 'ending' at eastern entrance to Avebury henge.
4. Logically possible avenue route 'starting' at actual location of Silbury Hill and 'ending' western entrance to Avebury henge.
6. Logically possible avenue route ending at western entrance to Avebury henge.

#### Notes

1. The 165 metre contour understates the obscuration effect of Beckhampton Road hill along Beckhampton Avenue. See Fig. 1 where hachured hill-shading gives a better indication of this effect.
2. Notice how most of the EBA barrows can be observed on surrounding false crests from various parts of the Avebury complex. Those on the summit of Waden Hill, for example, are due east of the Longstone Enclosure and Adam and Eve stones, and those on Windmill Hill can be seen from the Sanctuary cropped by the northern end of Waden Hill.

Adapted from Powell (1996: 11)



fourteen rejected pairings from the one chosen? A second opportunity to introduce variability presents itself with the near-level plain north of Avebury Circle around Windmill Hill. Why did the builders not locate Silbury Hill alongside Windmill Hill in this open countryside? Placed at the end of the hypothetical avenue 1, as shown by the black circle in Figure 1, then this option allows another 15 possible paired avenues with Silbury Hill in this re-located position north of the Avebury Circle. We now have 30 logically possible paired Avenues with Silbury Hill either in its actual southern position or its logically possible northern position. If we can find any properties that distinguish avenue pairing 3 & 5 with Silbury Hill in the south from the remaining 29 possible logical alternatives, then we can subject these to analysis.

TABLE 1 Visibility of Silbury Hill, south and north, from all possible paired avenues: (measured by variation), [measured by number of views], {excluding circle centre views and double counting (X)} in cols. 3 & 4.

Combination	Combination #	Silbury Hill South		Silbury Hill North	
1:2	1	(0,1)&(0,1)	(=4)[2]{0}	(1)&(1)	(=2)[2]{2}
1:3	2	(0,1)&(1,0,1)	(=5)[3]{X}	(1)&(0,1)	(=3)[2]{1}
1:4	3	(0,1)&(1)	(=3)[2]{1}	(1)&(0,1)	(=3)[2]{1}
1:5	4	(0,1)&(1,0,1,0,1)	(=7)[4]{X}	(1)&(0,1)	(=3)[2]{1}
1:6	5	(0,1)&(0,1)	(=4)[2]{0}	(1)&(0,1)	(=3)[2]{1}
2:3	6	(0,1)&(1,0,1)	(=5)[3]{X}	(1)&(0,1)	(=3)[2]{1}
2:4	7	(0,1)&(1)	(=3)[2]{1}	(1)&(0,1)	(=3)[2]{1}
2:5	8	(0,1)&(1,0,1,0,1)	(=7)[4]{X}	(1)&(0,1)	(=3)[2]{1}
2:6	9	(0,1)&(0,1)	(=4)[2]{0}	(1)&(0,1)	(=3)[2]{1}
3:4	10	(0,1)&(0,1)	(=4)[2]{X}	(0,1)&(0,1)	(=4)[2]{0}
<b>3:5 (WK &amp; BA)</b>	11	(1,0,1)&(1,0,1,0,1)	(=8)[5]{3}	(0,1)&(0,1)	(=4)[2]{0}
3:6	12	(1,0,1)&(0,1)	(=5)[3]{X}	(0,1)&(0,1)	(=4)[2]{0}
4:5	13	(1)&(1,0,1,0,1)	(=6)[4]{X}	(0,1)&(0,1)	(=4)[2]{0}
4:6	14	(1)&(0,1)	(=3)[2]{1}	(0,1)&(0,1)	(=4)[2]{1}
5:6	15	(1,0,1,0,1)&(0,1)	(=7)[4]{X}	(0,1)&(0,1)	(=4)[2]{1}

Assuming at this stage that we are walking along each (real and hypothesized) avenue towards the Avebury circle, and without prematurely characterizing the nature of the view of Silbury Hill other than by noting whether it can be seen or not, we can code our walk along all thirty possible paired avenues as binary inter-visibility options. For example, in Table 1 for combination 1 which pairs avenues 1 and 2, setting off from each avenue with Silbury Hill in the south, in both cases the hill is initially out of view until once in the Avebury Circle, where it finally comes into view. This is recorded in Table 1 as (0,1)&(0,1) (=4), meaning four intervisibility options of Silbury Hill are afforded by this combination of avenues. If Silbury Hill were located in the north, then it would be in view all along both avenues 1 and 2, and this perspective affords just two views of a northerly located Silbury

Hill, coded as (1)&(1) (=2). For the actually chosen processional ways of West Kennet Avenue and Beckhampton Avenue with Silbury Hill in the south, combination 11, the number of inter-visibility options is larger. At the Sanctuary, Silbury Hill can be seen. But once we drop down from the Sanctuary and follow the course of the Avenue, Silbury Hill disappears from view all along its remaining length until we re-enter the Avebury Circle. When we start along Beckhampton Avenue at Fox's Covert (see below) we at first see Silbury Hill, and then as the Avenue sweeps round towards the Adam and Eve stones (Fig. 1), all views of Silbury Hill are blocked by the hill topped by the modern Beckhampton Road. This is a particularly startling property, since it is a matter of locating the Avenue in places just 100 metres or so north of the modern Beckhampton Road, from which can be seen a direct and dramatic view of Silbury Hill. Unlike the steep sides of Waden Hill, the gentle slope of Beckhampton Hill offers no great impediment to locating the Avenue all along its ridge, so it is very clear that for this stretch of the Avenue the builders intended *not* to see Silbury Hill. Not until Beckhampton Avenue drops down to the valley of the River Winterbourne does Silbury Hill return into view, only to once again drop out of sight walking towards Avebury Circle, from where again it can be seen. We represent this as: (1, 0, 1)&(1, 0, 1, 0, 1) (=8), offering a total of eight inter-visibility options. We repeat this exercise for every combination of two avenues out of all possible avenues with Silbury Hill located either south or the north of Avebury Circle (See [ ] in Table 1).

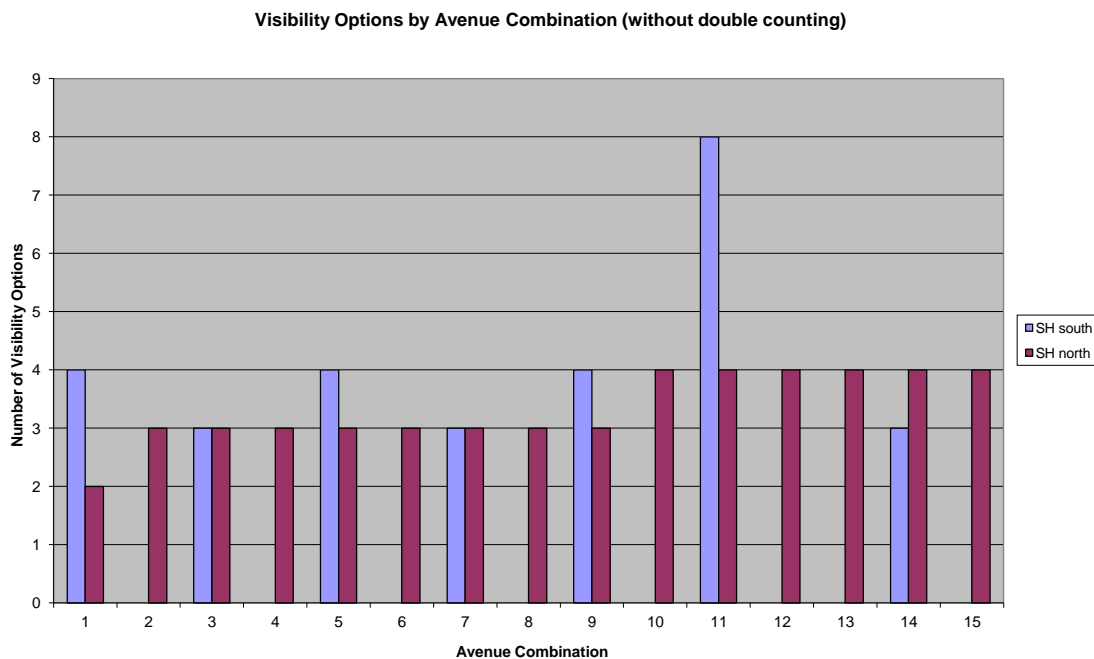
In comparing all possible avenue combinations with the chosen combination 11, we need to exclude double counting by removing those combinations that share either West Kennet Avenue or Beckhampton Avenue when Silbury Hill is in its southern position (See { } Table 1). Of the remaining 22 possible combinations shown in Chart 1, it is clear that the avenue routes chosen by the Avebury builders were those which afforded eight options as against the maximum of four allowed by any other combination. If this property is of any significance, we would therefore predict that optimally *all* of the five views (See [ ] Table 1) provided by this route are significant in some way. We will test this hypothesis by looking at the views provided by other possible avenue routes.

## Binary versus analogue views

We will set aside for the moment the views of Silbury Hill from the two centres within the Avebury Circle, and concentrate only on the inter-visibility options offered by all new



Chart 1



pairings of logically possible avenues. Of the 22 logically alternative paired routes, only 3 *new* combinations offer any qualitative contrast to avenues 3 and 5: first along avenues 1 and 4 with Silbury Hill in either the south or the north, and secondly along avenues 2 and 6 when Silbury Hill is in the north alone. The remaining 18 possible combinations are all variations on the themes offered by any other combination. Views directly towards or away from Silbury Hill, whether south or north along Avenues 1 and 4, are all *analogue* views of Silbury Hill – which gain or lose in height depending on the distance of the processing observer. Such an arrangement would be consistent with ‘central place’ or ‘handicap’ theory. As they provide an uninterrupted view of a huge ‘pyramid’ appearing to grow in size as approached along an avenue, this could be seen either as signalling a culture’s centralizing cosmovision, or its ability to subsidize monument building (Blanton et al. 1990, Zahavi et al. 1997). In rejecting avenue routes 1 and 4, we can now see that in their choice of the skirting routes 3 and 5 the monument builders wanted an aspect of Silbury Hill from a roughly *constant* distance. This re-confirms our original decision to classify inter-visibility options between avenues and Silbury Hill in a binary code – when viewing is obstructed by an adjacent hill, then that particular view is preserved in the observer’s memory by being ‘switched off.’<sup>55</sup> However avenue pairing 2 and 6 with a northern location for Silbury Hill also keeps it at a constant skirting distance, and are the mirror image of West Kennet and

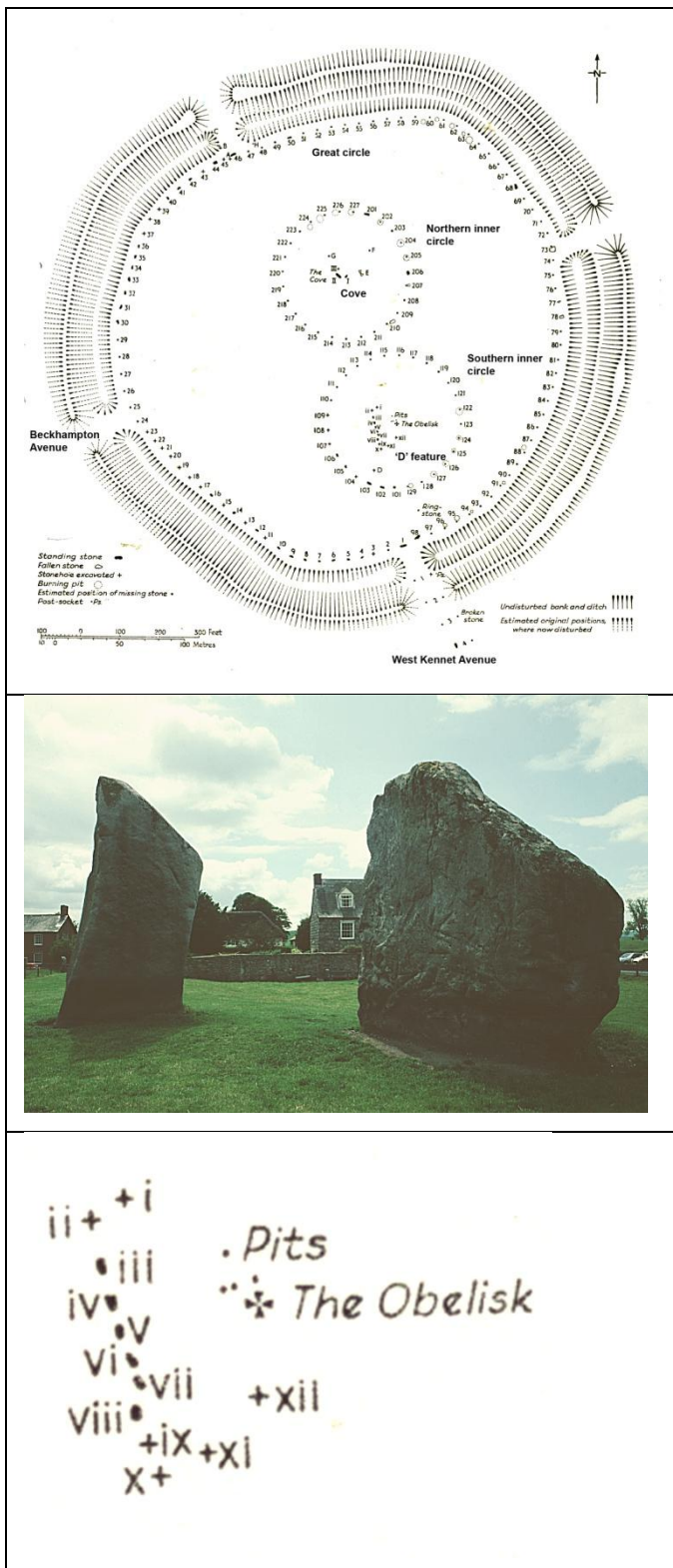
<sup>55</sup> Similarly, Tilley (1994:178) found a digital alternation of the views of Penbury Knoll when walking the Dorset Cursus.

Beckhampton Avenues, but radiating from the northern rather than southern half of the Avebury Circle. They differ by processing along an almost flat plain, rather than through a landscape interrupted by two hills as in the chosen southern half of the Avebury complex area. This option was also rejected by the builders. Therefore the Avebury builders chose a route for their two avenues which *required* the interrupted viewing options provided by the two hills south of the Avebury Circle, and avoided the opportunity to build avenues across a featureless level plain. This deduction of the builders' intentions encourages us to look at the nature of these views.

### **Avenue views of Silbury Hill**

The route of West Kennet Avenue allows just one view of Silbury Hill, and then only from its Sanctuary 'end' – from here its level top can be seen to fit a notch in the background western horizon and continue the line of the flanking horizons (Fig. 5.5, also see North 1996: 87; contra Barrett 1994: 31 and Devereux 1991: 895). What of Beckhampton Avenue? To answer this question, a brief digression is necessary, since little remains of Beckhampton Avenue and opinion as to its course and indeed existence has varied. In spite of detailed and reputable eye-witness accounts in the early eighteenth century by Stukeley (1724) and the Reverend Thomas Twining (Burl 2002: 218; Ucko et al. 1991, 38), archaeological opinion up to 1999 was sceptical that the Avenue had ever existed (Gillings et al. 2008, 365). Then a resistivity survey and later excavation recorded traces and found remains of the Avenue in exactly the positions described by Stukeley up to the Longstones Enclosure (Burl 2002, Cripps 2001, Gillings 2000, Gillings et al. 2000). However the resistivity survey and a 50 x 40 metre trench found no traces of the Avenue just west of the Longstones enclosure which, according to the excavators, provides 'conclusive proof that the avenue did not continue in its known form beyond the Longstones Cove' (Gillings et al. 2008, 71). In 2003 a similarly sized trench was dug along a previously unexplored section of the West Kennet Avenue in a roughly symmetrical location to that of the Longstones Enclosure, but found no trace of the avenue (Gillings et al. 2008, 139). And more stones have been found along the suggested course of the Beckhampton west of the Longstones Enclosure than had ever remained along the now re-discovered section (Cripps 2001: 3, Gillings 2000: 14, Glastonbury 2008). Therefore in one location site excavation could find no remains of the West Kennet Avenue which is known to exist 'in some form', and more stones remain along a route

**Figure 3 Avebury circles, Cove and 'D' feature**



Notes (from top to bottom)

1. Avebury circle adapted from Smith 1965: 205. Stone 102, mentioned in the text, is shown in the south-south-west sector of the Southern inner circle.
  2. Cove looking south-south-west. According to Stukely, another stone once stood in the foreground matching the stone to the left of this photograph.
  3. Magnified plan of 'D' feature from centre of southern inner circle.
- Source: Smith 1965: 205 and author's photograph.

than where a previously rejected avenue has now been found to have existed. In short, there are reasons to trust Stukely and Twining that, in some 'form', the avenue did in fact start or end at Fox's Covert. Beckhampton Avenue allows two views of Silbury Hill. At Fox's Covert, Silbury Hill can be seen protruding above the eastern horizon (Fig. 5.1). At the point where the Beckhampton Avenue crosses the River Winterbourne, Silbury Hill can be seen with its summit platform exactly in line with the background southern horizon (Fig. 5.2). Paradoxically for the remaining 70-80% of their length both the Avenues' courses are *designed* to obstruct all view of Silbury Hill.

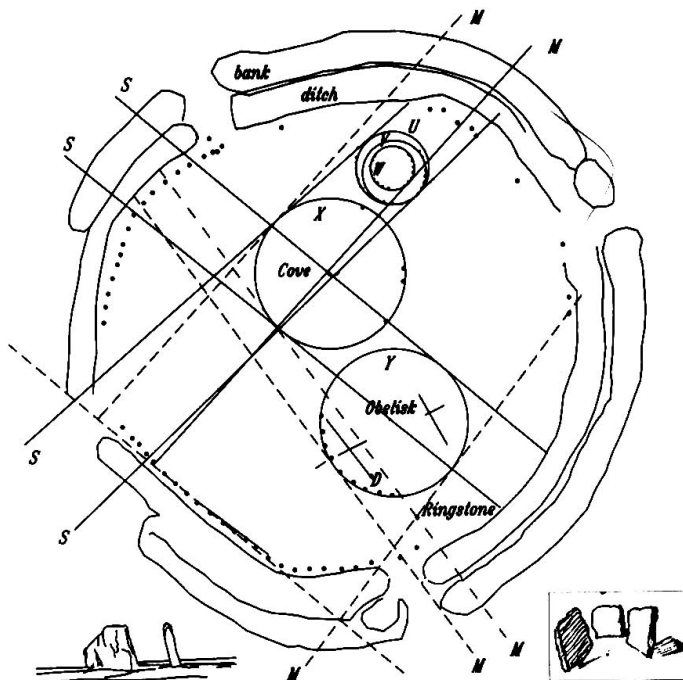
### **Avebury Circle views of Silbury Hill**

Common to all possible avenues are the views of Silbury Hill from Avebury Circle. Thomas has suggested that the top of Silbury Hill can be seen from the centre of the southern inner circle, at the place where the 'Obelisk' used to stand within the 'D' feature (Thomas 1999, 217). This is not the case, and views of Silbury Hill from the two centres of Avebury Circle need to be specified more precisely (see Devereux 1991). Avebury Circle straddles an undulating ridge which falls to the west and to the east away from the centres of the two inner circles. Looking to the south-west from the central areas of these two inner circles the top of Silbury Hill could have been seen protruding above the north-western lip of Waden Hill (Fig. 5.3). However, standing either west or east of these two centres within the Avebury Circle, the observer's eye drops with the ground level and the cropped top of Silbury Hill disappears from view. At the centres of these two inner stone circles were two megalithic features. In the northern inner circle was a 'Cove' of three enormous 'quadrangular' stones in an open-topped 'sentry box' arrangement (Fig. 3 and inset on Fig. 4), the backstone of which is probably the largest stone moved in British prehistory. In the centre of the southern inner circle was the 'D' feature, in which a row of 12 small stones (i – xii in Fig. 3.3) were combined with the 'Obelisk' at the apex of the 'D', reported by Stukeley as the tallest stone pillar in the Avebury complex at 21 feet high, with four pits (Figs. 3, 5.3 and 5.4). How does marking these two central areas of the Avebury Circle in this way influence our embodied viewing of Silbury Hill?

## The Cove

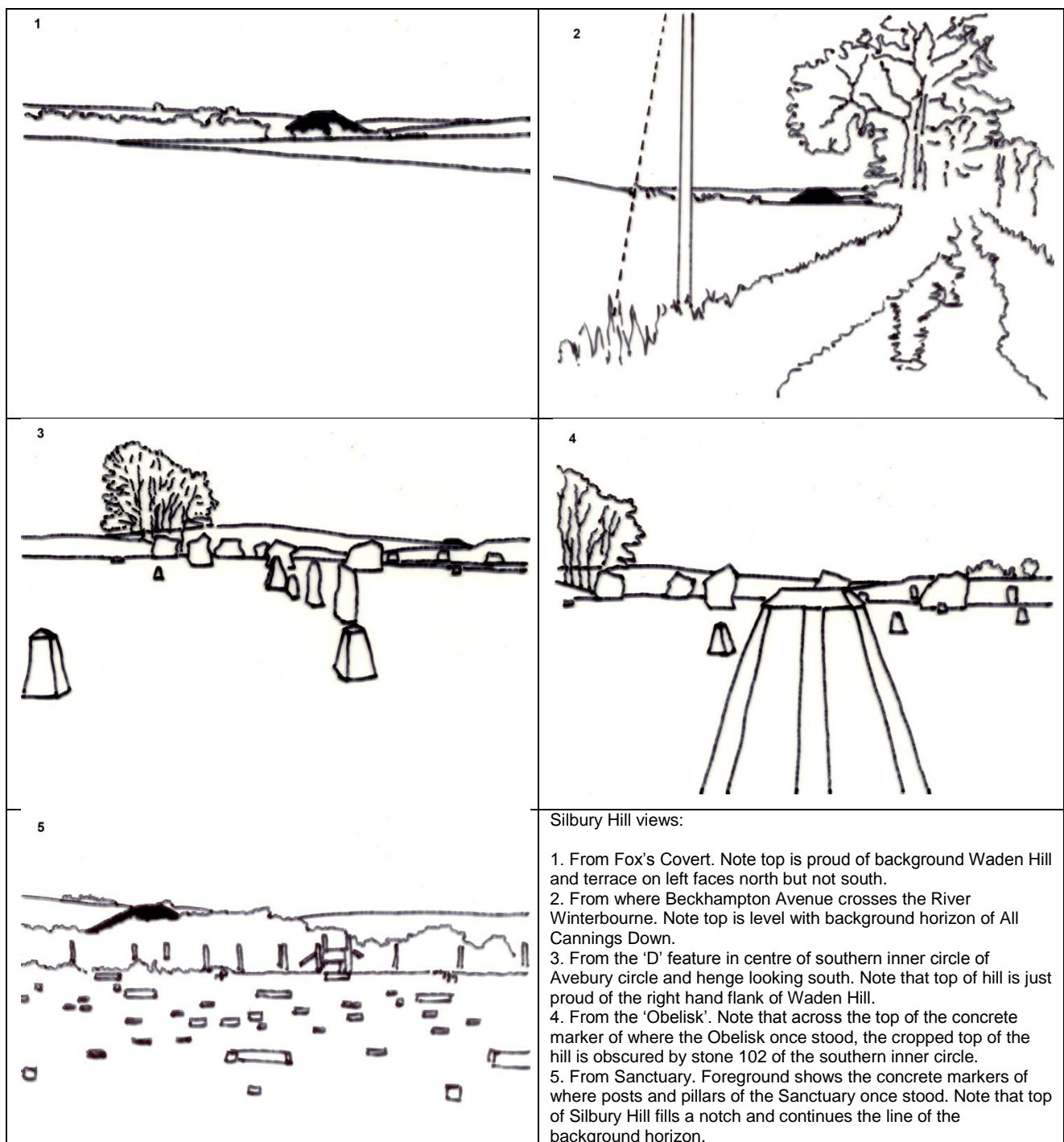
While the top of Silbury Hill *could* have been seen peeping above the northern silhouette of Waden Hill, paradoxically the Cove is designed to impede that view. Its 'sentry box' design is an 'engulfing' or 'enclosing' space, albeit with large gaps at the intersection planes of the three stones (See Fig. 3 and inset in Fig.4). As an 'open box' arrangement of three huge stones, it is not a space to *circle* but one to *enter or look through*. Looking from within the Cove it principally directs the eye out of the open box towards a level, featureless horizon, or secondarily along the lines of orientation of the flat sides of the stones. This 'embodied' description of the Cove sensitizes us to its form and its landscape context. However, it does not explain its orientation. The open aspect of the 'sentry box' Cove is turned away from Silbury Hill and looks towards the north-east. Occupying such a privileged place would, within the assumptions of landscape archaeology, expect an elaboration rather than obstruction of this view of Silbury Hill. The limits to landscape phenomenology can now be transcended by turning to archaeoastronomy. Burl and North

**Figure 4 The chief internal astronomical alignments set by the components of the Avebury circles according to North (1996)**



(North 1996, 274 with permission)

**Figure 5      Silbury Hill views prescribed by Avenue routes and 'D' feature in Southern inner circle of Avebury Circle**



Source: Line tracing from author's photographs.

have variously shown that the Cove, in consort with the no-longer visible double post-circle that once existed just to the north east of the inner north stone circle, acts as an

'astronomical' focussing device. It can be seen from Figure 4 that from the south-west quadrant of the Great Circle a ray threaded uphill through the inner face of the left-hand side of the Cove 'box' past the post circle outer circumference to the northern major standstill moonrises. In a reverse alignment, now standing from a position in the north-east quadrant of the Great Circle, another ray looks uphill again along the opposite stone's flat inner side to the south west to the winter solstice sunset. And in a transverse alignment, standing in the south-east quadrant of the Great Circle and again looking uphill past the outer edge of the southern inner circle and along the flat of the back-stone to the north-west, the summer solstice sunsets can be seen on the small section of henge bank in the north-west. In each case all of the inner flat edges of all three stones provided an alignment when the observer's eye is lowered by standing below the central ridge at certain stones of the outer Great Circle. The corner gaps of the Cove frame the bursts of the setting suns at both winter and summer solstice, similar to how the Altar Stone and grand trilithon do for the winter solstice at sarsen Stonehenge (North 1996). And again, similar to walking into sarsen Stonehenge from the Heel Stone, by processing uphill from behind the post-circle towards the Cove the observer's rising eye would have counter-balanced the motion of the setting winter solstice sun to create the illusion of 'time' standing still (North 1996, Sims 2006).

### *The 'D' feature*

While Burl and North's archaeoastronomy works well for explaining the alignment of all three stones of the cove in the inner northern circle, the same is not the case for the 'D' feature at the centre of the inner southern circle. Only the Obelisk and the Ringstone, in combination with the stone circles as shown in Figure 4, are explained by alignments on the summer solstice sunset and the southern major standstill moonsets. No other components of the 'D' feature are explained by these alignments. Therefore the 'row' and pit part of the 'D' must have another property not explained by archaeoastronomy. The phenomenology of stone rows can assist by 'walking' the row. As we walk these 12 stones to end at the Obelisk, their average height of about 1.5 metres does not impede surrounding views, as do the Cove and almost every other stone in the entire henge, and provide a clear view of the top of Silbury Hill peeping over the north-western edge of Waden Hill. Walking the row of the 'D' feature counter-clockwise from the northern stones down to the south (stone i to x in Figs. 3.3 & 5.3), the cropped top of Silbury Hill in the

south-west diminishes as we walk towards it until, when we reach the thirteenth stone of the Obelisk, all view of Silbury Hill is blocked by the large quadrangular slab of stone 102 (Fig. 3, Fig. 5.3, 5.4).

### **Silbury Hill top ‘terrace’**

At its fullest extent, the cropped view of the top of Silbury Hill is exactly that part of the hill above the top terrace mentioned by Devereaux (1991). Landscape archaeology would perhaps see in this a replication of the many re-workings of the encircling ditch and embankment around the summit of Windmill Hill. Seen this way the Silbury Hill top terrace mimics, albeit on a smaller scale, the view of a line of scoured chalk that would have been seen on Windmill Hill. This might be interpreted as a celebration of local space, where the venerable marker of early Neolithic Windmill Hill was reinforced and replicated in the late Neolithic and EBA Silbury Hill. While this may be a plausible narrative, repetition in itself does not tell us what is being repeated. Why build a ‘causewayed enclosure’ on Windmill Hill and then a millennium later make a smaller version of it as Silbury Hill, which has a top terrace that does not encircle the top of Silbury Hill, and embedded within a monument complex arranged to allow just seven views from a few restricted positions?

The clue to decoding these properties lies in their combination. Notice that if the builders had only wanted a cropped view of Silbury Hill from the centre of the southern inner circle they could have built a much *smaller* hill just behind the near horizon of the northern end of Waden Hill. Building a *big* Silbury Hill near the southern end of Waden Hill allowed, through the property of binary inter-visibility options from the Avenues, the suite of views of the Hill we have found from three other Avenue locations. This point re-confirms that these other views were required for the meaning of the monument complex to emerge from its actual location. But it does not address the precise form of the terrace, which diminishes in its southern quadrant. Rather than seeing this feature as a problematical and asymmetrical terrace, if its function were to present a clean line of chalk to observers in the Avenues and Circle, then repeated scrapings of the near-upright face would generate exactly the asymmetry we see. If we are not over-interpreting, then the very unusual and variable aspects for Silbury Hill from these various vantage points severely reduces the number of plausible explanations we may construct for the Hill. If so, then it is our



responsibility to demonstrate that all of them are amenable to a single, over-arching explanation.

That the builders' selection of views was intended is clear from the 'start' of the Beckhampton Avenue. The Avenue could have started about a kilometre west of the modern Beckhampton roundabout on the Calne Road at a higher altitude than at Fox's Covert (Fig. 1, 13). This would have provided *another* view of the top of Silbury Hill exactly level with the distant horizon. If this aspect of Silbury Hill were for some reason valued by the builders, as it seems to be in two other locations, why not also here? Instead, the builders chose a route for the 'start' of the Beckhampton Avenue at the lower altitude of Fox's Covert, which affords a view of Silbury Hill not level but proud of its background horizon. Table 2 lists the seven prescribed views of Silbury Hill seen from both Avenues and Avebury Circle. For reasons that should become clear I will examine these component views in the order: 4, 5, 6, 3, 1, 7, and 2.

### **Silbury Hill as lunar facsimile**

After this long preparation of the data, we are now ready to suggest an interpretation. We have good reason to suspect that the Avebury Circle, in common with sarsen Stonehenge and 322 other stone monuments of the period, were elaborations of a complex cosmology which confiscated lunar properties and placed them into lunar-solar cycles (Sims 2006). Also, in keeping with both Thom's (1971) and North's (1996) suggestions<sup>56</sup> that the largest stones in a monument usually signified a lunar alignment, then just as with the grand trilithon at sarsen Stonehenge, so the Cove and the Obelisk would be expected to be associated with some aspect of the moon. There is also direct evidence for solar and especially lunar symbolism at Avebury. Alignments on the sun's solstices and the moon's major standstills are found in the circle and on the major and minor standstills of the moon in the West Kennet Avenue (North 1996, 252-62). The 13 stones in the 'D' feature, 29 stones in the inner southern circle, 27 stones in the inner northern circle, and 98-100 stones in the Great Circle (Burl 2002, Smith 1965) all involve lunar-solar periodicities.<sup>57</sup>

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<sup>56</sup> Scholarship has still to come to a measured judgement of the work of these two authors. See Heggie 1981 and Sims 2007 for a critique.

<sup>57</sup> There are 13 new moons or 13 full moons in one year; 29 (or 30) days from one new moon to the next; it takes 27 (actually 27.3) days for the moon to circle the earth and return to the 'same' position in the sky; and 99 months is the minimum number of months to coincide with a whole number of years - 8.

Table 2 Taxonomy of Silbury Hill views prescribed by Avenues and Avebury Circles

View of Silbury Hill from:	Aspect:	View bearing:
Beckhampton Avenue at Fox's Covert	1. Top of Silbury Hill protrudes above distant horizon.	East (5° south of east).
Beckhampton Avenue at River Winterbourne	2. Flat top of Silbury Hill coincides exactly with background level horizon.	South (77° south of east).
Cove at centre of northern inner circle of Avebury circle	(View obstructed by modern buildings) 3. Cove arrangement turns away from Silbury Hill.	South-south-west (82.5° south of west)
'D' feature at centre of southern inner circle of Avebury circle	4. Rounded profile of top of Silbury Hill proud of sloping horizon of Waden Hill. 5. Variable height of rounded profile of top of Silbury Hill walking south along the row of stones of the 'D' feature. 6. At Obelisk, view of Silbury Hill blocked by stone 102 of southern inner circle.	South-south-west (79.8° south of west).
Sanctuary	7. Flat top of Silbury Hill fills a notch in background horizon, and coincides exactly with level of flanking horizons.	West (16° north of west).

The gleaming line of white chalk seen peeping over Waden Hill from the stone row of the 'D' feature in the centre of the southern inner circle might also have been intended to represent the first or last glint of the moon. Rather than merely asserting these five properties, we now set ourselves the task of testing whether the seven<sup>58</sup> prescribed views of Silbury Hill from avenues and henge are consistent with it.

Looking from the northern end of the stone row in the 'D' feature (Fig. 5.3) affords the largest profile of the top of Silbury Hill as a short arc of white chalk peeping over the top of the north western lip of Waden Hill, suggesting the horizon viewing of the first or last glint of the moon. As the orientation of this view is to the south-south-west (Table 2), and as a rounded line of chalk, this could represent a last glint of the waxing crescent moonset but not the waning crescent moon. This is because waxing crescent moons can only be seen at their settings after the sun has set, and waning crescent moons can only be seen at their risings before the sun has risen, but not vice-versa . Before sunset or after sunrise the waxing and waning crescent moon's light is swamped by the light of the sun. During the winter solstice period of any southern standstill, dark moon always coincides with the week of winter solstice sunsets (Sims 2007). This suggests that as the southern inner circle is designed for a ritual at dark moon at winter solstice, then waxing new moon would be an appropriate conclusion to such a ritual, since new moon appears about 2 days after

<sup>58</sup> The seventh 'view' from the Cove, which is blocked (see Table 2), needs another explanation which will be left to a later paper.

dark moon. The two properties – Silbury Hill as setting waxing crescent moon and southern inner circle as the place to mark a standstill dark moon at winter solstice – are therefore consistent with each other. Waxing crescent moon's first appearance two days after dark moon at winter solstice will be in the evening sky in the south-south-west, to the *left* of winter sunset. From the centre of the southern circle the alignment of Silbury Hill is about 80° south of west (Table 2), well to the *left* of the winter solstice sunset.

These four properties of the view of Silbury Hill from the northern end of the stone row in the 'D' feature – colouration, shape, ritual consistency with southern inner circle standstill alignments, and south-south-west alignment – support the hypothesis that it represents a setting new moon. Walking along the stone row of the 'D' feature towards the south, and therefore towards Silbury Hill, the increase in the steepness of the angle of view is sufficient for the protruding top of Silbury Hill to gradually dip below the horizon of Waden Hill. By the time we have completed the walk of the row, and ended at the Obelisk, direct viewing is obscured by the southern entrance stone 102 (Fig. 3 & 5.4; see also Devereux 1991). Therefore walking counter-clockwise around the 'D' feature towards the Obelisk, the Silbury Hill chalk summit slowly sets below Waden Hill and finally disappears at the Obelisk. And as the new moon appears each night to the left of its previous position in the sky, this 'widdershins' movement of the body replicates that of the moon. The Avebury builders have devised through the observer's movement a way to represent a dynamic representation of new moon setting below the horizon. Seen in combination, the Cove and the 'D' feature manipulate the opportunities offered by the central ridge that runs through the Great Circle. It allows cropped and dynamic views of Silbury Hill from the southern circle and the presently unexplained choice to ritually avoid this view from the northern circle. And from key outer stones of the Great Circle, lunar and solar alignments through and past the inner circles offer a clear view of the sky above the elevated central ridge. These properties define the location, scale and much of the architecture of the Avebury Circle.

At the 'start' of Beckhampton Avenue at Fox's Covert, we see Silbury Hill protruding above the *eastern* horizon. This fits the requirement of the lunar template as waning crescent moon, which can only be seen rising just before dawn one or two days *before* dark moon, but not at its setting. For a ritual to be phase-locked to synchronize with dark moon at winter solstice, this suggests that *this* particular ritual began from the Fox's Covert end of

Beckhampton Avenue to see a line of chalk protruding above and *not* level with the background horizon. This explains why Beckhampton Avenue does not start higher by the Calne Road.

We have now dealt with five of the seven aspects of Silbury Hill presented by the monument complex at Avebury. All five are consistent with the hypothesis that a wall of chalk just below the summit surround is a representation of the first or last glint of crescent moon in its waning crescent, dark, and waxing crescent phases on the horizon when rising and setting. What of the remaining two views of Silbury Hill, from the Sanctuary and from the Beckhampton Avenue junction with the River Winterbourne?

### **Entering the underworld**

The two remaining views of Silbury Hill so far unexplained both artfully place it with its flat top in line with the background horizon - from the Sanctuary and from where Beckhampton Avenue crosses the River Winterbourne. There could not be a more dramatic signifier of crescent moon under the horizon. Landscape archaeology can add further meaning to this finding, especially when we factor into our interpretation that both views are bracketed with a descending route and the use of the River Winterbourne as the crossing point for the Beckhampton Avenue viewing position. Applying this to a culture steeped in a lunar-solar cosmology, the phenomenological emphasis on active agency allows us to make one final inference. What possible conclusion could a person walking *down* from the Sanctuary, and along Beckhampton Avenue *down* into the Winterbourne valley, draw from seeing the Silbury Hill crescent moon *when it is just below the background horizon*? There is only one place from which the moon under the horizon can still be seen. That place is the underworld. *Descending* along the two avenues at these places, which includes the requirement to cross a winterbourne river (Lincoln 1991: 62-75), was an embodiment designed by the builders as a metaphor for entering the underworld.

### **Conclusion**

This paper has explained 27 or so features of Silbury Hill in its Avebury monument complex with a single model of lunar-solar conflation.<sup>59</sup> Critics will have to come up with

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<sup>59</sup>They are: Height of Silbury Hill in lowest location; no burials; shape of Silbury Hill; lunar-solar alignments in circle are *not* on Silbury Hill; rigorous isolation of Avenue route properties from 30 logically possible routes; summit terrace; Windmill Hill; seven prescribed views of Silbury Hill; largest stones in Avebury Circle for dark

either errors in the data or an alternative and more compelling interpretation of so many features. The method of quantifying landscape as a region of alternatives allows us to isolate the builder's desired landscape context and prescribed views for these monument's complex architecture. By seeking all of the qualitatively different logically possible alternative locations and therefore views, we can infer prehistoric intentions by seeing if there is any special portfolio of properties in the actually chosen location which are not available elsewhere. The method of horizon 'astronomy' reveals that one function of the Avebury circle was to time a ritual at dark moon at the winter solstice sunset. On inspection, the seven prescribed views of Silbury Hill from the Avenues and Avebury circle possess an emergent structure when combined with the horizon 'astronomy' of the Avebury circle. As an integrated cosmological system, Silbury Hill in its landscape and monument context acts as a dynamic lunar facsimile in dark moon rituals at winter solstice. This structural property is designed, by aligning the Silbury Hill summit in line with its back horizon, to rely on the agency of the participants to construct the landscape as a journey into and out of the underworld. Walking from Fox's Covert at the 'start' of Beckhampton Avenue we see Silbury Hill as 'rising' waning crescent moon on the eastern horizon. Crossing the River Winterbourne we see it as the crescent moon under the horizon. We enter the Avebury Circle for a dark moon ritual at the Obelisk with its pit connections to the underworld. When walking the 'D' feature row counter-clockwise we see setting new moon. Then to end at the Sanctuary to see new moon set on the western horizon. This eastwards procession along the Avenues is in reverse direction to the westwards march of the heavenly bodies across the sky, and as the Silbury Hill 'moon' scrolls through its phases before, during and after dark moon, it is in keeping with constructing the underworld as a mirror image reversal of 'this world'.

I have already shown how a similar method which actively seeks discontinuity works to explain the axial alignments at sarsen Stonehenge, and is generally applicable in landscape research (Sims 2006). When attempting to interpret prehistoric monuments or cultures penetrated by colonialism, we are left with a degraded complexity of just some residual components of a once integrated cosmology. The procedure of combining a quantified landscape phenomenology, the detailed architecture of the monument and

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moon simulation of Silbury Hill; numbers of stones in Avebury circles; chalk wall of terrace; central ridge of Avebury henge; scale of Avebury circle; height of 'D' feature stones; Cove alignment; no analogue avenues for full moon simulation in Silbury Hill moat; all Avenue routes go downhill at the three locations when they allow views of Silbury Hill; crossing a river when Silbury Hill 'set' on horizon; 'D' feature pits; walking the Avenues in either direction confers meaning.

horizon 'astronomy', which could also use for example the patterns of depositional archaeology and Indo-European poetics, raises the level of each component once it is re-integrated as a system to the level of ethnographic meaning. This method overcomes the limitations of nominalism in phenomenology while retaining its emphasis on the need to include agency in cultural interpretation. It also allows an integration of archaeological and archaeoastronomical data which transcends the 'fallacy of division' (Armstrong 1978), and reveals the emergent anthropological properties of an ancient cosmology.

## NOTES

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**Sims, L.D. (2009) 'The Logic of Empirical Proof: A note on the course of the Beckhampton Avenue,' *Time and Mind* 2:3, 333-345.**

## **The logic of empirical proof: a note on the course of the Beckhampton Avenue.**

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### **Abstract**

After 150 years of archaeological scepticism towards Stukeley's 18<sup>th</sup> century claim for a Beckhampton avenue in the Avebury monuments, Gillings et al. (2008) have finally confirmed that it did in fact exist. However, contra Stukeley, they only allow its existence up to the site of the 'Longstones Cove', and dispute its continuation further to the south-west to Fox Covert, as claimed by Stukeley. This paper attempts to demonstrate that by documentary method, field survey, geophysics, site excavation, and the method of critical experiment, this interpretation fails the normal standards of the logic of empirical proof. This failure to sustain their case leaves Stukeley's claim for Beckhampton avenue continuing to Fox Covert standing and open to further investigation.

Keywords: Stukeley; Beckhampton avenue; Avebury; proof, archaeoastronomy.

The Beckhampton avenue is one of two avenues of parallel rows of stones claimed by Stukeley to be part of the Avebury monument complex in Wiltshire, England. The complex includes the largest prehistoric stone circle and earth mound in the world - Silbury Hill (Burl 2002). The antiquarian Stukeley's 1743 view of the complex in Figure 1 shows Beckhampton avenue 'starting' at Fox Covert and approaching the Avebury Circle from the southwest across the River Winterbourne. The avenue is roughly symmetrical to another avenue, the West Kennet avenue, which exits the Avebury circle to the south east and follows the course of a dry valley to 'terminate' at a smaller stone and post circle named 'The Sanctuary'. The Avebury monuments were built in the third millennium BC and are about 20 miles north of Stonehenge<sup>60</sup>.

Until 1999, many British archaeologists doubted Stukeley's claim for the existence of Beckhampton Avenue, including Lukis, Piggot, Ucko, Pollard, Gillings, Whittle, Thomas, and Parker-Pearson (see discussion and references in Gillings & Pollard 2004: 6 and Gillings et al. 2008: 58-62). Their view before 1999 was that very few stones could be observed along the claimed route, and that therefore Stukeley's testimony could not be trusted. This doubt was set by some archaeologists in the latter half of the nineteenth century, when it was considered improbable that an avenue would cross a river, and that

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<sup>60</sup> See Gillings et al. 2008 for full list of references on all these and other features.

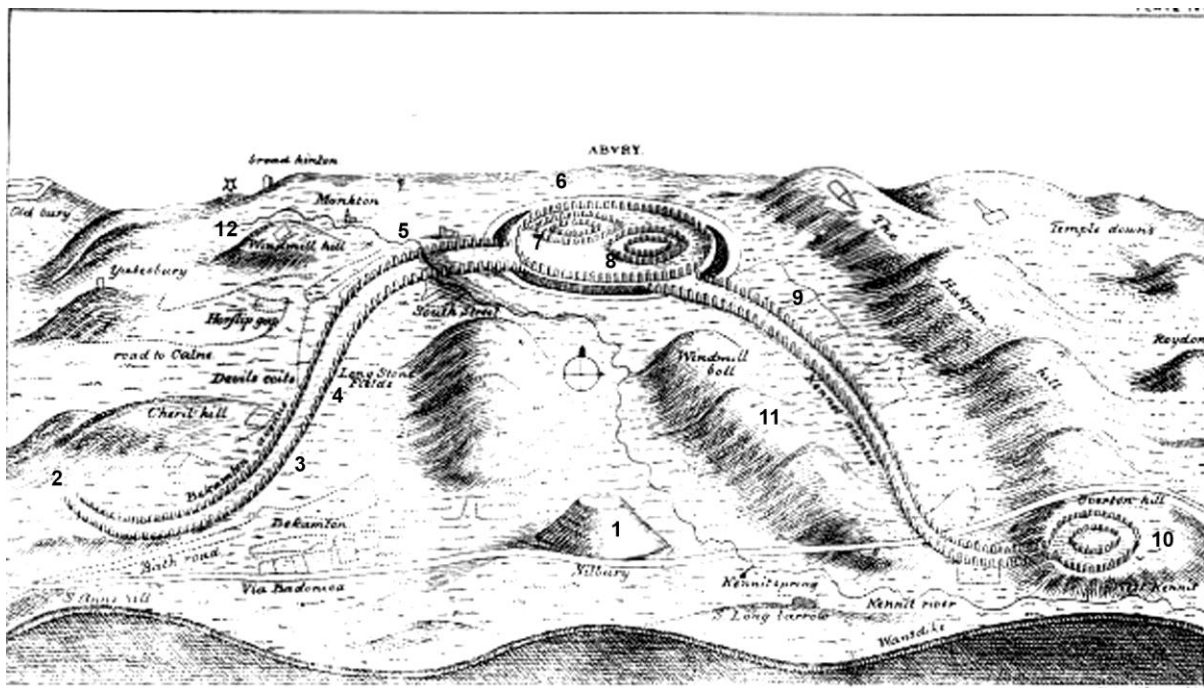
the very few stones to the west of the Avebury circle could be more parsimoniously explained as remnants of other unconnected features. However, there has always been another constituency within British archaeology that accepted the existence of the Beckhampton Avenue. While initially sceptical, when the western entrance to the Avebury circle was re-discovered by Keiller in 1939, he changed his view and accepted the possibility of a Beckhampton Avenue. Together with Keiller, King, Twining, Stukeley, Smith, Burl and Vatcher all support the view that the Beckhampton avenue existed and continued to Fox Covert. The issue was always therefore one of *interpretation* on the basis of incomplete evidence, and the professional disinclination of many archaeologists to accept Stukeley derives from a long-held and arguably overly-sceptical and ambiguous frame of mind towards his work (Ucko et al. 1991:240).

Since 1999, fieldwork conducted by Gillings et al. has led them, like Keiller before, to change their mind on the existence of the Beckhampton avenue (Gillings et al. 2008). Geophysical surveys and digs by them between 1999 and 2003 found paired rows of buried stones and stone holes to the east of Adam's Cove 'exactly where he [Stukeley] had identified it' (Gillings & Pollard 2004, 19). This rediscovered avenue overlay an earlier structure – the Longstones Enclosure. Gillings et al. and Pollard now argue that in fact the Beckhampton avenue did exist and ran a course from the Avebury Circle to the Longstone Cove but, contra Stukeley, they argue it did **not** extend further to the south west to terminate at Fox Covert. The main evidence for this claim is that a geo-physics survey and 50 x 40 metre trench dug immediately to the south west of the 'Adam' stone failed to reveal any buried stones or stone-holes (Gillings et al. 2008, 71). As they invoke the criteria of empirical proof, then this claim can itself be subjected to the accepted standards of inference and proof.

#### Evidence from Antiquarian testimony

Two destruction episodes, one in the late Middle Ages and another in the early eighteenth century, denuded much of the Avebury monuments. Reputable antiquarian testimony is important for us today since it was made before some of the destruction had been completed. But Stukeley's was not the only or the first antiquarian report of the Beckhampton Avenue. Independent of and before Stukeley, Reverend Twining also reported that the Beckhampton avenue continued on to Fox Covert (Burl 2002, 218;

Fig. 1 Stukeley's 'A Scenographic view of the Druid temple at Avebury in north Wiltshire as in its original'



Key: 1 – Silbury Hill; 2 – Fox Covert; 3 – Beckhampton Avenue; 4 – Adam's Cove/Longstones Enclosure; 5 – River Winterbourne; 6 – Avebury Circle; 7 – northern inner circle; 8 – southern inner circle; 9 – West Kennet Avenue; 10 – Sanctuary; 11 – Waden Hill; 12 – Windmill Hill. (Adapted from: Mortimer 2003: 50-1.)

Gillings et al. 2008, 365-6; Peterson 2003). Two identical but independent testimonies suggest that they were both drawing upon local folk knowledge of the monuments. In fact '...several decades later, the curate of Avebury, Reverend Lucas recorded that an elderly parishioner, John Clements, could still point out the line of the avenue at the time of his death.' (Malone 1989, 93) and 'Stukeley was reliant on oral history for much of his information' (Ucko 1991, 182). Since two antiquarians and a folk culture independently came up with similar claims, this raises the credibility of any one of them.

The archaeological reticence to accept Stukeley's testimony for a Fox Covert start/terminus location for the Beckhampton avenue (Fig. 2) is partly based upon the suspicion that he made its course fit his post 1725 'serpent' theory of the monuments, and that this degrades the validity of his documentary evidence. This raises a number of issues that were resolved by Ucko nearly two decades ago (Ucko et al. 1991). First, the claim for a Fox Covert 'start' to the avenue was made before 1725. Second, the presumption within archaeology that his pre-1725 field data is accurate compared to his post-1725 'serpent' record is not justified (Ucko 1991, 244). Third, before 1725 he developed a geomantic theory by which the avenues and circle followed a rigorous symmetry around Silbury Hill, and he predicted the Fox Covert 'start' would have a temple just as the West Kennet

'terminus' had the Sanctuary. After intensive fieldwork failed to locate such a temple he dropped this claim, and started searching for other interpretive hypotheses for the Beckhampton avenue (Ucko et al. 1991, 87). In short, the integrity of the field data took precedence over the theory. Fourth, it is inconsistent for Gillings et al. to reject Stukeley as a valid documentary source with respect to the Fox Covert claim, but to accept it as a fieldwork and excavation site guide for other research strategies (eg. where to locate their exploratory trenches around the Trusloe Cottages (Gillings et al. 2008, 105); accepting Stukeley's accuracy for the location of the West Kennet cove as under the road for not testing for its existence (Gillings & Pollard 2004, 20); the avenue's course around West Kennet village (Gillings et al. 2008, 129-33)). Fifth, there is a qualitative difference between the detailed descriptive sections of his record compared to the interpretive sections. For example, in the Stukeley 'Stonehenge 1723' manuscript held at Cardiff Central Reference Library there is a loose sheet recording Stukeley's bearings taken around Avebury (Burl & Mortimer 2005, Appendix 2)<sup>61</sup>. We can map these readings against known locations today and, allowing for the 4° of error of Stukeley's theodolite (Burl and Mortimer 2005: 152), Beckhampton avenue is noted on this sheet triangulated with many other extant features of the Avebury complex. Sixth, many archaeologists also doubted the existence of the Sanctuary until detailed use of Stukeley's testimony led to its rediscovery (Ucko 1991, 242). In summary, multiple sources, documentary method and logic enhance the validity of Stukeley's claim for a Fox Covert start/terminus for the Beckhampton Avenue against an overly sceptical professional archaeology.

### Evidence from field survey

Field survey should expect less surviving evidence of stones for the Beckhampton avenue compared to the West Kennet Avenue, since building stone would be in demand in the area where the village was built, west of the Avebury circle, compared to the uninhabited area around the West Kennet Avenue. Further west beyond the village along the claimed course of the Beckhampton avenue are racing horse stables and gallops, and their staff would have been directed to clear the area of hazardous sarsen stones. Only a single pair of recumbent stones was recorded by Stukeley along the Beckhampton Avenue to the east of the Longstones enclosure<sup>62</sup>. Yet far more sarsen stones have been found or

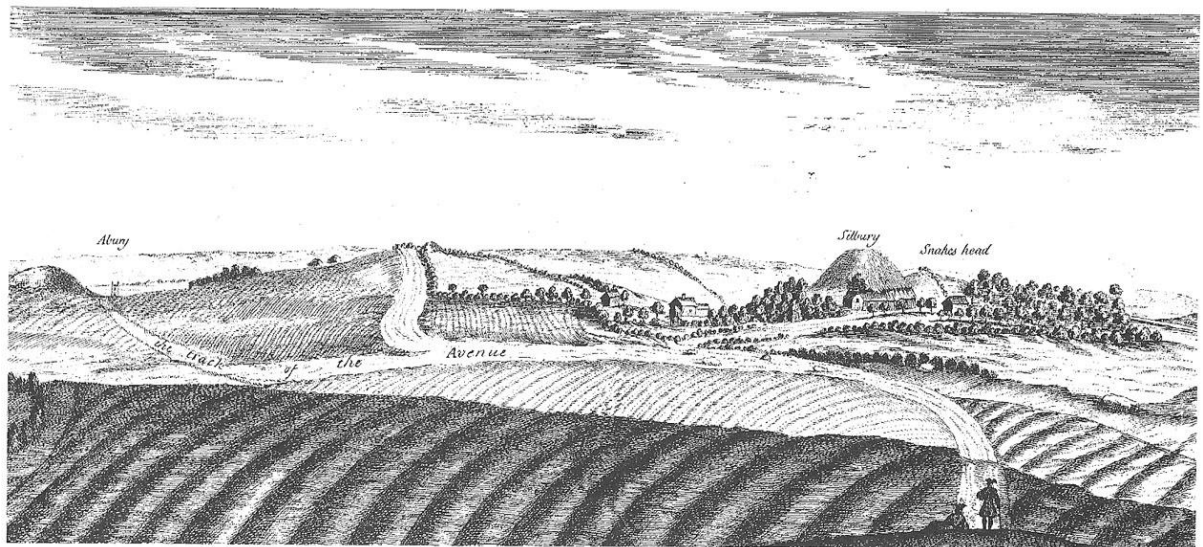
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<sup>61</sup> With thanks to Neil Mortimer for pointing out this source to me.

<sup>62</sup> Others have been found by Pete Glastonbury as foundation stones for the River Winterbourne bridge:  
<http://www.peteglastonbury.plus.com/Apod/Apod30.htm>

recorded in the area west of Longstones Cove on the route for the Beckhampton Avenue proposed by Twining/Stukeley extending to Fox Covert. These are: two or more stones

Fig.2 A view near the spot of the termination of Beckhampton avenue, according to Stukeley. July 19 1723



Mortimer 2003: 68.

were reported to have been moved by Richard Fowler around 1700 at the cross roads of Calne Road and Field Way; Vatcher's stone of the 1969 excavation; a stone is shown on the map on page 110 of Gillings et al. 2008 close to the A361, although not discussed in the text. The local antiquarian Pete Glastonbury has reported further stones around that area, many cleared from fields that the horses are exercised in so as not to risk these valuable animals: 2 stones on the Beckhampton road, one large one on the left by the small woods which may have been the covering stone that Faith Vatcher excavated in the 1960's when road works uncovered a child burial (SU 08549 68797); on the right of the road by the paddock and low down in the ditch is a triangular shaped stone which marked a Gypsy grave (it used to be in the woods but was moved (SU 08694 68877)); in the stables is a pile of quite large sarsens in the garden in a heap which can only be seen in the winter months (reported to him by the jockeys in the Waggon & Horses); in the hedgerow behind The Grange there are two stones standing deep in the undergrowth that have been reused as an old gateway (SU 08669 69247); on the old Calne road is a buried stone which Stukeley was shown (SU 08339 69042); and in Beckhampton there are around 30 large stones used as garden ornaments, which probably came from 'Chapel



Field', close to the house now named 'Silbury Court' (Pete Glastonbury: personal communication).

Although there may be some double-counting in this listing and, according to your assumptions on how many whole stones they may indicate, this adds up to between 8 and 40 possible stones on the route of the Beckhampton avenue *to the south and west* of the Longstones Cove. Gillings et al. seem to be unaware of these further stones recorded by Pete Glastonbury. But since the scarcity of stones east of the Longstones Cove was the basis for earlier archaeological rejections of the existence of the Beckhampton avenue but which is now known to have existed, then more stones to the west of Longstones Cove *adds* weight to the Antiquarian report that the Beckhampton avenue extended further west. Gillings et al. discount these stones as variously: separate monuments; removed from Avenue terminal at Longstones to mark outlying region; abandoned from unfinished projects; Mediaeval burial; sarsen-capped flat Beaker burial located close to Beckhampton spring (Gillings et al. 2008,109). Pete Glastonbury sees the Beckhampton garden's stones not as avenue remains, but as collected from natural sarsen drift in Chapel Field, named after a chapel that once stood at the site of a house now named 'Silbury Court'. These six additional theories to explain these extra stones, alongside the hypothesis of a short Beckhampton Avenue, are a more complicated alternative to the more parsimonious Antiquarian testimony that all this evidence can be explained by a single Beckhampton avenue continuing to Fox Covert.

#### Evidence of geophysics survey and site excavation

Gillings et al. geophysics survey 50 metres to the south west of Adam's Cove did not show any underground anomalies which might indicate buried stones or stone-holes. However, magnetometer and ground radar surveys frequently do not show underground features which exist because of variable soil and other conditions: "...the geophysical re-location of former stone settings can be particularly difficult, and is often of itself unable to provide unequivocal solutions" (Gillings et al. 2008, 11, 63, 67, 70, 103). Similarly, a geophysics survey of an area close to the Trusloe Cottages, midway between Longstones and the Avebury Circle, was expected to show traces of six stones, but actually showed possible traces for two. Subsequent excavation within this area instead revealed just one stone. Therefore instead of producing evidence for six stones the two methods combined showed definite evidence for only one – a failure rate against expectation of 83% (Gillings et al.

2008, 105). Even in this archaeologically most studied area, the enormous West Kennet Palisades just east of Silbury Hill were unknown until a full excavation had been carried out (Gillings et al. 2008, 3). Except for Vatcher's excavation which did find a sarsen buried near the Beckhampton roundabout, there has been little excavation for the remaining course of the Beckhampton avenue claimed by Stukeley.

In 2003 a similar sized trench was dug along a previously unexplored section of the West Kennet avenue in a roughly symmetrical location to that of the Longstones Enclosure. However, here also no trace of the West Kennet avenue was found (Gillings et al. 2008, 139). The authors conclude that '...any assumption that the entire course of the Avenue comprised regular paired stone settings could represent a simplification of a more varied structural form.' And "...the assumption of an unbroken line of stone pairs may not hold for the full length of both avenues." (Gillings et al. 2008, 103, 109 respectively). Since the West Kennet avenue is known to extend to the Sanctuary another kilometre or so to the east, then it is as likely that the empty excavation just west of the Longstone Enclosure is also a break in the continuity of an avenue that in fact extends further to the west, just as it does eastwards past the gap in the West Kennet Avenue.

#### Evidence anomalous to theory

With the excavation of a 50 x 40 metre area to the south west of the Longstones Cove – 'No stone-holes, stone destruction pits or stone burials were present, providing conclusive proof that the avenue did not continue in its known form beyond the Longstones Cove' (Gillings et al., 2008, 71). However the phrase '...in its known form..' is inconsistent with '...conclusive proof...'. If it did exist in another form, then it is 'conclusive proof' of not much at all. And since we now know that its 'form' included substantial gaps, then this statement is disingenuous. This inference is a consequence of Gillings and Pollard's 'monuments as memory of ancient track-ways model' (Gillings & Pollard 2004, 34 and 81). Such a model would find it hard to accommodate two avenues, unlike the one at Stonehenge, and would find it even harder to accommodate two discontinuous avenues. Instead of a rigorous testing of their own model, their conclusion for a short Beckhampton avenue coupled with additional explanations for the many stones to the west of Longstones Cove could be seen as a *post hoc* adaptation to anomalous evidence.

If Avenues were a monumentalised memory of ancestral track-ways, then it seems that culture-bearing modern humans first entered the Avebury area as Mesolithic hunter-gatherers along the Kennet Valley. From mappings of their base camps and extraction camps, Allen has shown their track-ways would have included both the Kennet Valley and the dry valley which includes Fox Covert, but *not* the valley later followed by the West Kennet Avenue. Assuming that Gillings and Pollard allow their memory model to extend to the monument builders' Mesolithic ancestors, then Allen's work would predict that Beckhampton Avenue, not West Kennet Avenue, would be remembered by later 'lithicisation' (Allen 2005). Perhaps it is the model, rather than the evidence, which is anomalous. Since memory also locks onto ritual and myth, not just ecological memory, then the monument builder's monumentalisation of their forager memory may have required dispensing with the memory of their ancient track-ways precisely to utilise those different parts of their local landscape which provided the best context for conducting their rituals and telling their myths. No Mesolithic sites were located on Windmill Hill, or the 'occupation area' of West Kennet avenue or the place of the Avebury circle. Yet these might have been exactly the right places to preserve aspects of that waning life for the cattle herders of the Neolithic/Early Bronze Age (EBA). Cosmological memory could, following this set of ethnographic assumptions, be best preserved by relocating monuments within a 'new' landscape that evoked those myths to conduct rituals that were being adapted to and constitutive of their new circumstances.

Such an approach would overcome the now refuted 'impediment' of a river crossing for a stone avenue. Rather than seeing rivers and wet places as a disadvantage to a processional way that monumentalised ancestral entry routes, it may well be that for initiatory journeys into a simulated underworld they were a preferred component of a monument complex (Sims 2009 and below). There is plenty of evidence for this hypothesis. The Avenue at Stonehenge may well have been extended to the River Avon once the water table subsided below ground level at Stonehenge Bottom (Darvill 2007, 159); the Dorset Cursus was designed to descend into a marsh at the source of the River Allen (Tilley 1994: 184); and the longest stone row in the British Isles from Stall Moor to Green Hill in the Erme Valley on Dartmoor crosses the river and a large marshy triangular patch of red pebbles halfway along its 3.4km length (North 1996: 245-6; Sims 2003 field-notes). Transit across or through a stretch of water or bog may well provide the digital alternation from wet to dry, such as provided by Beckhampton to West Kennet Avenues, which is a component of many initiation rituals. Burials where the Beckhampton avenue

crosses the River Winterbourne are additional signifiers to the metaphorical meaning of crossing a river (ref?) into the underworld.

In an earlier publication, Gillings and Pollard found an indication of symmetry between the Beckhampton avenue and the Ring stone 'extension' of the West Kennet avenue as it approached the southern inner circle of the Avebury henge: '...[I]t is interesting to note that the last [sic] stone pair of the Beckhampton avenue before it entered the earlier enclosure also incorporated a perforated stone – an interesting symmetry perhaps?' (Gillings et al. 2004: 20). Interesting symmetry of a more substantial nature can be found between the Beckhampton and West Kennet Avenues:

1. The shapes and dimensions of the stones found buried in Beckhampton avenue are the 'same' as the stone shapes surviving in the West Kennet Avenue. (Gillings et al. 2008, 75).
2. The average rectangular spacing of Beckhampton avenue stones is 15 x 23 m., and that of the West Kennet avenue is 17 x 24 m. (Gillings et al. 2008, 64)
3. The transverse stone L4 near the Longstone Cove (Gillings et al. 2008, 63) could be considered symmetrical to the transverse stone 35a in West Kennet Avenue, which is also about one-quarter along its route to the Sanctuary.
4. Part of the Gillings et al. justification for seeing the Longstones Cove as the terminus of Beckhampton avenue is that it is located alongside an early Neolithic/EBA 'cemetery' on Folly Hill. By the same token, if EBA burial mounds are used to signify a symbolically potent part of the landscape, why discount Stukeley's claim of the Fox Covert, since that is also the location of another line of EBA burial mounds?
5. The Beckhampton avenue passed directly through the Longstones east entrance 'just as' the West Kennet avenue passed through the gap in the Occupation area holes (Gillings et al. 2008, 81). But as the Occupation area is within the length of the West Kennet Avenue, by making this observation of symmetry between the two avenues implies that the Longstones is also not a start/terminus point for the Beckhampton Avenue.
6. It could equally be argued that from its location alone the Longstone's Cove and Folly Hill 'cemetery' was a structure integrated into the course of a *longer* Beckhampton Avenue, just as Falkner's Circle is part of the way along the course of

the West Kennet Avenue, or the King Barrow Ridge burial mounds are part of the Stonehenge Avenue mid-way along its length.

7. The concentration of lithics found around the Longstones Cove is echoed in the lithic concentration in the 'Occupation Area' part way along the West Kennet Avenue.
8. The crouched inhumation burial at the Longstones Cove is on the north east side of the 'Adam' stone with its head to the south east. West Kennet avenue inhumation burials are also on the north east side of the stones and for the one where there is evidence, the head was pointing to the south west (Smith 1965, Plate 36a). Archaeologists have frequently identified cardinal and cross-cardinal alignments in prehistoric burials (Tuckwell 1975), and these alignments could only have been achieved by 'astronomical' means. As there is a suggestion here of an orthogonal relationship between the two Avenue's burials, then there may be grounds for accepting an archaeoastronomical rationale of this lateral inversion in the symmetry of the Avenue 'burials'.
9. Behind the Sanctuary which marks the 'terminus' of West Kennet avenue there is a line of barrows at right angles to the approaching avenue axis. But the line of the Folly Hill barrows, favoured by Gillings and Pollard to mark the 'terminus' of the Beckhampton avenue, is parallel, not transverse, to the line of the avenue. However, at Fox Covert there is a linear barrow 'cemetery' at right angles to the line of the Beckhampton avenue as it 'begins' its route to the Avebury Circle as suggested by Stukeley. If the principle of symmetry between the two avenues is accepted, then the Fox Covert barrows would be a better candidate for marking the start of the Beckhampton Avenue.
10. According to Stukeley, West Kennet avenue also had a cove about half-way along its length. If this was the case, then it would mirror the Longstones Cove along the Beckhampton Avenue, as a feature not signifying the terminus but an intermediate perhaps mid-way point along a longer Beckhampton avenue. Stukeley described this other cove in detail, as a three-sided arrangement of stone pillars on the east side of the avenue opening out to the south-west 'opposite one recumbent stone, two vacant stone positions and three fallen stones. Furthermore, at this point in the avenue, which he called the "Apex", he records that one of these Cove stones was "carried away 1723" and another "just buried"'. He also included a drawing of it in his panorama of the avenue. Ucko adds in the same passage that '...it is exactly

this kind of apparently detailed evidence that has made it so difficult to discount Stukeley's claim for the existence of a Beckhampton avenue' (Ucko 1991, 190-3). Since we now know that the Beckhampton avenue existed, then perhaps a more appropriate rule would be that wherever Stukeley provides 'detailed evidence', as is the case with the West Kennet avenue cove, we should strive to conduct exhaustive tests rather than prematurely doubt his testimony. Gillings and Pollard suggest that if the cove existed it would now be buried beneath the modern road, so that Stukeley's claim is unable to be tested (Gillings & Pollard 2004, 20). However it may be that the West Kennet avenue cove was located in a position which can be tested. According to Pete Glastonbury the West Kennet cove was 70m north of the existing stone on the west side of the road, or where stone pair 50 should be assuming average spacing. From field survey in that position is a flat, high area of ground with clear horizon views all round, just as the Longstones and northern inner circle Coves are positioned on local raised ground. This position is confirmed by Stukeley's triangulation data in the Cardiff library source mentioned above, and therefore the West Kennet avenue Cove's existence may be testable.

These ten pieces of evidence for symmetrical form and properties between the two avenues strengthens the case for extending symmetry to their length and course, which in turn indicates the start/terminus for Beckhampton avenue at Fox Covert (North 1996, 248-64).

#### Evidence from theoretical pluralism

Facts become 'facts' when they are predicted by theory. A 'processions' perspective which views avenues as monumental reminders of ancestral transit routes would find it difficult to accommodate duplication and discontinuity into their design and would also minimise the significance of local landscape features that might be appropriated for ritual purposes. However, other theories can. Cleal has demonstrated a frequent association between monuments and bourne holes, which 'might have appeared mysterious, liminal, a reminder of the forces inhabiting the landscape and only intermittently apparent...[I]n the Beckhampton Road 'dry valley' ...[d]uring the wet winters of the 1990s and the early 21<sup>st</sup> century the northern part of the valley had rising ground water extending from south-west of the junction of the Roman road with the present road...Lining this stretch of valley are concentrations of round barrows, including linear settings, *particularly at Fox Covert ...*'

(Cleal 2005, 122, my emphasis). The ritual amplification of the periodic emergence of water from underground by constructing an avenue which 'starts' at Fox Covert is consistent with seeing the Avebury complex as intended to simulate a journey into and returning from the underworld (Sims 2009). Stukeley noticed that the Avebury monuments were organised in a highly paradoxical arrangement – '...every part is hid from the other or but obscurely visible...' (Ucko et al. 1991, 84). When we submit these digital alternations between obscured and 'obscurely visible', we find that the course of the two avenues prescribe horizon views of the upper terrace of Silbury Hill from only five positions, and are designed to disallow all other viewing for nearly 80% of their length - from Fox Covert; Beckhampton avenue where it crosses the River Winterbourne; the Avebury circle Cove; the 'D' feature; and the Sanctuary. Seeing the top terrace as a sliver of scoured chalk these views allow the Silbury Hill summit to be perceived as crescent moon before and after dark moon at the winter solstice. From two positions, at the River Winterbourne and at the Sanctuary, the Silbury Hill summit is perfectly in line with the background horizon. There could not be a more dramatic signifier of the moon when it has set. It would be apparent to prehistoric participants in ritual processions in the Avebury monuments, that only from the underworld can the moon be seen when it has set. In particular, as can be seen in Fig 2, while Beckhampton avenue is shown by Stukeley as a track with few stones, at it's 'start' it points directly to the Silbury Hill summit proud of its background eastern horizon, which is the only direction in which waning crescent moon can be observed, and the line of sight follows the line of the flow of water as it periodically emerges from the underground at exactly that spot. Discontinuous water flows, and digital alternation between dark and new moon rituals timed to coincide with the solstices, if reflected in the monument design, would then explain duplication and discontinuity in avenue arrangements. Since these different theories predict very different properties for the avenues, the scholarly procedure in testing your preferred theory is to always test the critical opposing theory. It is surprising that Gillings et al. do not suggest further exploratory geophysics and trenches in the area around and to the east of Fox Covert.

## Conclusion

This note is not intended to advocate an uncritical attitude to Stukeley's testimony (see Ucko et al. 1991, 157 and passim). It may be the case that Gillings et al. are correct in their view of a short Beckhampton avenue. But that case won't stand with these

arguments. Scholarship moves forward by attempting to refute our own hypotheses with every test available to us. Since field walking for stones, geophysics, and one short trench excavation cannot provide guaranteed tests to Twinings and Stukeley's claim for a Fox Covert start/terminus to the Beckhampton Avenue, other tests are required. By antiquarian and folk testimony, divided opinion amongst current scholars, direct evidence of stone remains, differential processes of monument destruction, inconsistent valuation of Stukeley's testimony, the unreliability of geophysics survey, logically inconsistent argumentation, the complexity of the Avebury Avenues architecture, substantial evidence for symmetrical properties and arrangements between the two Avebury avenues, the evident integration of local landscape features (particularly water) with monument layout, and lunar-solar conflation theory – all of these account for twenty-four reasons which attest to the *probability* that the Beckhampton avenue did extend beyond Longstones Cove to the Fox Covert. Whether it continued intermittently, marked with stones, posts or just as a path is not considered by Gillings et al. An open and multi-disciplinary research agenda should not be forestalled by a premature closure of this probability.

## Notes

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## **Coves, cosmology, and cultural astronomy<sup>63</sup>**

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### **Keywords**

Cove; cosmology; cultural astronomy; emergence; transformational template.

### **Introduction**

Every culture has a 'cosmology' – a theory that integrates the sum total of experience with the collectively represented origins and nature of all their known worlds. These worlds may be underworld(s)/this world/above world(s) in pre-State societies, and multi-verse or any combination of all in the west. Many cosmologies are also religions. At the Sophia Centre<sup>64</sup> conference in Bath in June 2009, two seemingly unrelated contributions qualified what we might ever be able to say about 'cosmologies'. The theme of the conference was to explore whether anthropology and cultural astronomy could generate relevant definitions of and methodological approaches to the cosmologies of all cultures. Particular attention was paid to what future there might be for cultural astronomy in the light of the unresolved issue within anthropology of defining culture and the present restriction of the concept of cosmology to 'cold' or static small-scale or traditional societies. Within these debates a post-modernist contribution insisted that all theories of cosmology are just stories that tell us nothing about the world but a lot about the politics of the teller of the story<sup>65</sup>, and an archaeoastronomer argued that cultural astronomy is unable to interpret 'coves' since they are probably aligned on local landscape features and do not have the general relevance they might have if they were aligned on sun, moon or stars<sup>66</sup>. Therefore at a conference dedicated to find a general paradigm for the future of cultural astronomy one contribution denied the status of any truth claims, and another questioned the ability of cultural astronomy to interpret the horizon alignments of some of the largest structures of prehistory in the British Isles. Any discipline is judged by its ability to handle anxieties such as these, and this paper suggests that innovative interdisciplinary, inter-cultural, and inter-institutional collaboration can answer such criticisms and provide a fruitful future for cultural astronomy.

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<sup>63</sup> This paper is an elaboration of a talk given in a panel session of the Sophia 2009 Conference in Bath. I would like to thank Nick Campion for inviting me on the panel, and to all the other panel participants.

<sup>64</sup> [www.lamp.ac.uk/sophia](http://www.lamp.ac.uk/sophia)

<sup>65</sup> Panel contribution by Patrick Curry at 'Cosmologies' Sophia Centre conference, Bath, 6/06/09.

<sup>66</sup> Statement made by Clive Ruggles in the film 'Celebrating the Summer Solstice: The Pagan Experience' by Darlene Villicana, shown at 'Cosmologies' Sophia Centre conference, Bath, 6/06/09.

Let us pose the problem of defining culture and cosmology as simply and as starkly as possible – are we ‘lumpers’ or ‘splitters’? If we lump all the world’s cosmologies together to find their common elements, then this might provide a way forward to a unified future for cultural astronomy. But the danger of amalgamation is that by abstracting all detail except that which is common will require jettisoning most of the ethnographic detail of each culture’s cosmology – precisely the detail which carries cosmological meaning. All that would remain would be a few barren abstractions. Alternatively, if we retain all the distinctive detail of every culture’s cosmology, then this may provide the evidence for a thick description of their various meanings, but at the expense of separating off each culture from each other as unique and idiosyncratic. With the first approach we gain commonality but lose meaning, with the second we never achieve common ground. We can side-step this polarisation by acknowledging some recent discoveries of the life sciences – all of humanity shares a common and recent African origin. Fully modern cultural humans had evolved in sub-Saharan Africa by about 120k years ago, and the first group to successfully leave Africa did so about 80k years ago, carrying with them the genetic pool which accounts for all the out-of-Africa human variation today. All earlier hominids are not our ancestors, and the migrating wave of moderns rapidly displaced all earlier species of homo that left Africa, including Neanderthals in Europe. Therefore the biological differences between all of the world’s people today are tiny and recent. More than that, the mit-DNA evidence suggests that our earliest ancestors were matrilocal – ‘husbands’ moved into their ‘wives’ group. And one of the main pieces of evidence that these biological ancestors were culture-bearing is their systematic and sustained use of red-ochre for symbolic not utilitarian purposes. These findings are general for all early moderns in sub-Saharan Africa, and point towards the sharing of a common cultural ‘package’ (D’Errico 2003; Henshilwood & Marean 2003; Knight 1995; Knight et al. 1995). These are observations – not theories. This evidence reduces the number of possible cultural origins scenarios. A theory rooted in patriarchal assumptions, for example, would find it difficult to absorb the evidence of matrilocality *plus* red-ochre use. A cognitive theory would find it difficult to explain how matrilineal/matrilocal coalitions were replaced later by patrilineal/patrilocal coalitions with no accompanying significant neural changes. A diffusionist theory would find it difficult to explain the very different dates and regional variation for the adoption of ‘social complexity’. But we are a long way from sub-Saharan Africa before the last ice-age, and even if this model of our recent origins is correct all the world’s cultures have since differentiated themselves from their common heritage. What

might be the value of acknowledging a ‘lumper’ theory of a common culture and cosmology for our origins, and how might it be related to a ‘splitter’ theory that celebrates all subsequent diversity?

### **Transformational template**

The present variety in the world’s cosmologies cannot be explained, Mandelbrot-like, as ever more miniaturised or re-combined sets of the earliest cultural configuration. We cannot assume a chaos theory scenario of constant repetition of the same cultural rules at different levels of magnification. This approach works by formalistic regression, in which all later developments are reduced to their formal identity with the origins model, and abolishes the property of emergence in which new content suffuses old forms and qualitatively transforms social formations. But equally neither can we ignore the fact that all human cultures derive biologically and culturally from a common African heritage. For anthropology, and therefore cultural astronomy, to embrace all of the world’s cosmologies in their specificity, and to demonstrate a common thread in our humanity which can be traced back to our common origins, then just one option is left to transcend the lumpers/splitters dichotomy – we need a *transformational template* that can both explain the generic culture from which all cosmologies have derived, and this template must be amenable and explanatory of all subsequent transformations to which it has been adapted and moulded. This paper will first consider whether this is a reasonable way to proceed, then critique the two challenges to this view made at the conference, provide a test of this critique through an interpretation of coves, and finally suggest a possible future for cultural astronomy.

Three examples demonstrate the use of a ‘transformational template’. Levi-Strauss argued that nearly all of the variations in kinship and marriage systems of south-east Asia could be explained by sequences of small variations to an original patrilineal/patrilocal template (Levi-Strauss 1969). This model has been criticised for ignoring many examples of women’s power and control that cannot be explained assuming patriarchal beginnings. Nevertheless, the idea of a transformational template can be retained by positing instead an original matrilineal/matrilocal template. This allows the model to be reworked through positing the subsequent collapse of sororal solidarity and the emergence of male-led coalitions, so extending the transformational template backwards (Knight 1995). In a separate and later exercise, Levi-Strauss also showed that all the one-thousand or so

Amerindian myths followed a common syntax of rules which bracketed dichotomous pairs of motifs into a single system (Levi-Strauss 1986). It has been shown that the same grammar is exhibited in all Australian aboriginal myths and European fairy tales (Knight 1987). While the syntax (*langue*) is invariant, the political meaning (*parole*) is highly variable according to the socio-economic and political context of the myth telling. While Levi-Strauss interpreted this invariant syntax as reflecting the neural wiring of the brain, he also showed that the substantive content of this structure followed the universal theme of a male patriarchy myth – that women's primordial rule had to be overthrown by men to guard against women's chaotic inability to ensure cosmic order. Levi-Strauss's alliance theory of cultural origins, in which groups of brothers traded their sisters, could only allow an extreme misogynist theory of human cultural origins. It could not explain matriliney, matrilocality, and many other aspects of ritual which indicated women's power and role in human cultural origins. Nor did Levi-Strauss suggest a convincing explanation of why cultural origins had to begin with the male oppression of women. If instead the evidence and theory for primordial matrilineal/matrilocal clans is accepted, then this contrary evidence can be accommodated within a model of a subsequent counter-revolution against women. Once this amendment is made to his template, it can then include this otherwise unexplained anomalous data. A third example is lunar-solar conflation theory from cultural astronomy. Six regional groups of monuments of the late Neolithic/Early Bronze Age in the British Isles can be seen to be sharing the same 'astronomical' syntax of lunar-solar conflation that derives from an original lunar template that is being confiscated by an emerging male-led solar cult. Instead of monthly dark moons being the trigger for matrilineal seclusion rituals, now binary solstice dark moon rituals staged within monumental architecture are monopolised by a male shaman/priestly cult (Sims 2006, 2007, 2009a). These findings and interpretations are examples of 'transformational templates' that connect both a cultural origins scenario and explain the cultural resource and structure for subsequent cosmological modification. This realist position is able to combine a cultural origins model with the evidence for subsequent cosmological diversification, and is open to being tested against evidence.

## **Post-modernism**

Post-modernism denies the validity of any attempt to make a truth-claim that derives from a meta-narrative. The assumptions of post-modernism are two-fold – one is that any

interpretive claim is organised solely by the teller's political agenda, and secondly it assumes the null hypothesis - as we cannot directly observe reality then there is no observable order in the world outside of this politically imposed narrative. Of course post-modernism is correct in that everything we say or theorise is embedded in a political and cultural context. We do not directly observe reality – we construct it to make it intelligible. But that is not all we do. By a process of abstraction we decompose a complex whole into its constituent elements, study their properties in isolation, and then consider the emergent effects of their reconstitution. The recombination of interpreted elements admits only a very few arrangements, and these models of reality are the interpreted whole. We never see 'capitalism' directly, since this is an abstraction that some of us have constructed to make sense of the perceived order and connections of many other small observations. Whether we are right or not to impose this pattern called 'capitalism' is debatable and open to peer-review. But there is another arbiter of our truth claims – experience. Since societies and cultures vary and undergo change, then that very variation and change sifts out those elements and bring to the fore the key organising principles of a culture and cosmology, and this confirms or weakens whatever interpretations we made earlier. Therefore variability and change are a resource to test our initial interpretations of any order or pattern we observe in the world.

To be consistent, the post-modernist critique must be self-referential. If anyone attempting to make a truth claim about the world is driven by a political agenda, then that must also be true for a post-modernist who makes that claim. By the same token any proponent of post-modernism is also engaged in a political strategy by telling a story that inhibits another speaker from making any truth claim about the world. Therefore the political agenda of a post-modernist is against anyone asserting that the world is ordered in a certain way. Since to deny that they also operate a meta-narrative is tautological, the choice for post-modernism is therefore either nihilism or self-abolition. And as post-modernists do try and say *this* something about the world it is inconsistent and disingenuous, since that assumes that since this is their preferred model then not all stories are equally weak or driven *solely* by a political interest. We all, including post-modernists, use different types of tests to discriminate between weak and strong arguments and theories. Some 'stories' are better than others, and by various logical and not-so-logical procedures we all evaluate what interpretations we are prepared to conditionally accept. And if a 'story' that we presently call a theory is eventually superseded by another later when our grasp of reality has become stronger, then that

does not mean that the earlier version of reality we used was always 'wrong'. Frequently the new version has been able to include the previous version but now integrated into a more complete and rounded account that can simultaneously work on a higher level. For example, archaeology is going through a protracted and as yet unfinished critique and rejection of 'farming revolution theory' (Thomas 1999). This suggests that culture and institutional order only begins in the Neolithic, and rises out of the surpluses of agriculture. It is variously patriarchal, cognitive and diffusionist, according to the author. This theory flies in the face of the anthropology of hunter-gatherers, which insists that culture is fully elaborated and modern humans fully evolved long before farming and the Neolithic. Yet a bronze technology is an 'advance' over a lithic technology, but according to our transformational template this 'advance' is embedded within a social and cultural decline in the democracy and egalitarianism of the matrilineal clans. Lunar-solar conflation theory therefore fits with a spiral rather than a unilineal model of historical change which can include both a 'matriarchal' egalitarian hunter-gatherer model and farming revolution theory, but only by transcending the limits of farming revolution theory.

The choice for all is whether to risk making a claim about the world, or whether to reside in a bunker of self-doubt honing our ability to discern our and everybody else's political agenda. Clearly, if cultural astronomy and scholarship in general is to have any future, it lies with taking risks and in making testable interpretations of cosmologies. Let us see how confident we can be in such an exercise by a multi-disciplinary study of coves, with particular reference to the role of cultural astronomy in such an exercise.

## **Archaeoastronomy**

The cultural astronomy of prehistoric cultures is its sub-discipline – archaeoastronomy. Since the late seventies a new generation of archaeoastronomers have critiqued and extended the work of Hawkins and Thom in the fifties and sixties, and re-set the discipline on firmer foundations (see Fountain & Sinclair 2005, Hoskin 2001, North 1996, Ruggles 1999). In particular the professional umbrella organisations for archaeoastronomy - SEAC and ISAAC<sup>67</sup> - have encouraged field researchers to use statistical techniques on regional groups of monuments to test whether alignments found in any one monument are representative of the group. By dealing with aggregated sets of architecturally identical monuments from prehistory and using rigorous and pre-determined data selection and

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<sup>67</sup> SEAC: <http://www.archaeoastronomy.org/> ; ISAAC: <http://terpconnect.umd.edu/~tlaloc/archastro/> .



scaling procedures, this stage in archaeoastronomy has overcome much of the bias of previous research. However, the adoption of the statistical method was as much to do with overcoming a highly sceptical archaeological establishment and to establish a new academic discipline which they would accept had 'data'. Instead of the late twentieth century view within archaeology that 'astronomy' had no relevance to prehistoric cultures, it is now clear from a matured archaeoastronomy that most monuments in the Neolithic and Early Bronze Age (EBA) were intentionally designed with horizon alignments on cosmic bodies such as the sun, moon and stars. But the statistical method has never been the only method available to archaeoastronomy. Some monuments are unique and highly complex, so much so that aspects of their detailed architecture will only allow an 'astronomical' interpretation. For example the 'light box' above the entrance at Newgrange is accepted by all to be designed to let in the rays of winter solstice sunrise (Ruggles 1999, 129); the grand trilithon double window at sarsen Stonehenge has only been explained by its double alignment of identity on winter solstice sunset and the southern minor standstill moonsets (North 1996, Sims 2006); the Cove at the centre of the northern inner circle of the Avebury complex has been shown to be a lunar-solar focussing device (North 1996 and below). We can be confident that each of these interpretations are not committing 'the individualistic fallacy', since their architectural details are so unusual that no other hypothesis can displace these archaeoastronomical interpretations. However, such has been the weight of archaeological disfavour that archaeoastronomy has stuck to accumulating aggregated data sets, and there has been very little development in the cultural interpretation of the alignments that have been found. A discipline that stands still waiting for others to accept it is a discipline in danger. As a sub-discipline of cultural astronomy, archaeoastronomy needs to widen its conceptual vocabulary to enhance its ability for cosmological interpretation. The puzzling case of coves allows us to test the challenge of post-modernism and the methods of archaeoastronomy for the possible futures of cultural astronomy.

### **Coves – testing cosmological concepts**

Coves are found in monument complexes in the late Neolithic/EBA, and are tightly concentrated 'enclosures' of standing stones of three or four quadrangular orthostats in a rectangular or square plan. Very few coves are known – it has been suggested that there were three at Avebury, and other coves were at Arbor Low, Stennes, Stanton Drew and

Mount Pleasant in Dorset (Burl 1988). These structures include the largest stones ever moved in the prehistory of the British Isles – the back-stone of the Avebury Cove in the centre of the northern inner circle of the Avebury henge weighed about 100 tons (Gillings et al. 2008: 62-90). Doubt mixed with wonderment surrounds any discussion of coves - Burl has referred to them as 'structural enigmas' (Burl 1988). Site excavation of coves confounds the archaeologists – the Longstones Cove is associated with a human 'burial' and thousands of pieces of worked flint, while the Avebury Cove is not associated with any deposition and seems to have been 'swept' clean. In a film shown at the Sophia Conference in Bath in June 2009, British archaeoastronomer Clive Ruggles referred to the diverse properties of 'coves', suggesting that such diversity amongst such a small sample defeated interpretation. This paper will concentrate on the three coves within the Avebury monument complex, and then look briefly at the remainder in the light of our analysis of the Avebury structures.

The three coves thought to be at Avebury were the Avebury Cove at the centre of the northern inner circle of the Avebury great stone circle and henge, the Longstones Cove in the Beckhampton Avenue, and the Cove in the West Kennet Avenue (see Figs 1, 2, 3). Of the first, there are just two stones still standing of what is thought to have been a three stone structure, within the much denuded northern inner circle and Avebury henge. The Longstones Cove has just one stone still remaining, where originally there had been four (Gillings et al. 2008, 63-90). There is no remaining surface trace of the West Kennet Avenue cove, and we only know of it from the antiquarian testimony of William Stukeley (Ucko et al. 1991). A post-modern approach would see *all* interpretations of any one these coves as a story that provides no insight into the 'things-in-themselves', since this is posited as unknowable. Such is the level of abstraction of the post-modern critique, that all of the coves are considered *equally* unknowable. A realist approach would argue that there are increasing orders of problem for interpreting each of these three coves, but that it is possible to differentiate strong from weak explanations for all three of them.

Fig 1.1 The Avebury Cove today (author's photograph)



Fig 1.2 The Avebury Cove within the Avebury henge and circle, with North's (1996) interpretation of lunar-solar alignments. Stukeley's sketches of the cove are inset.

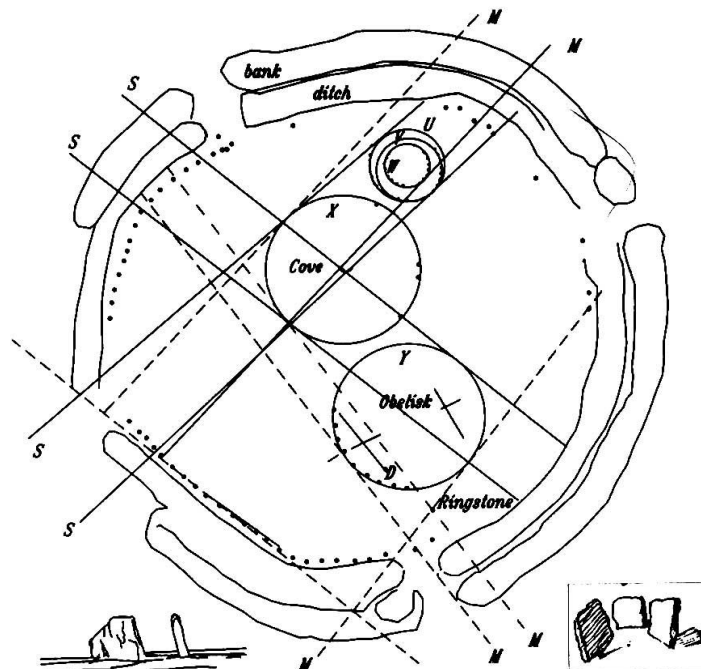


Fig 2.1 The Longstones Cove (L16, L15, L14 'Adam', L11) in the Beckhampton Avenue (Gillings et al. 2008, 63)

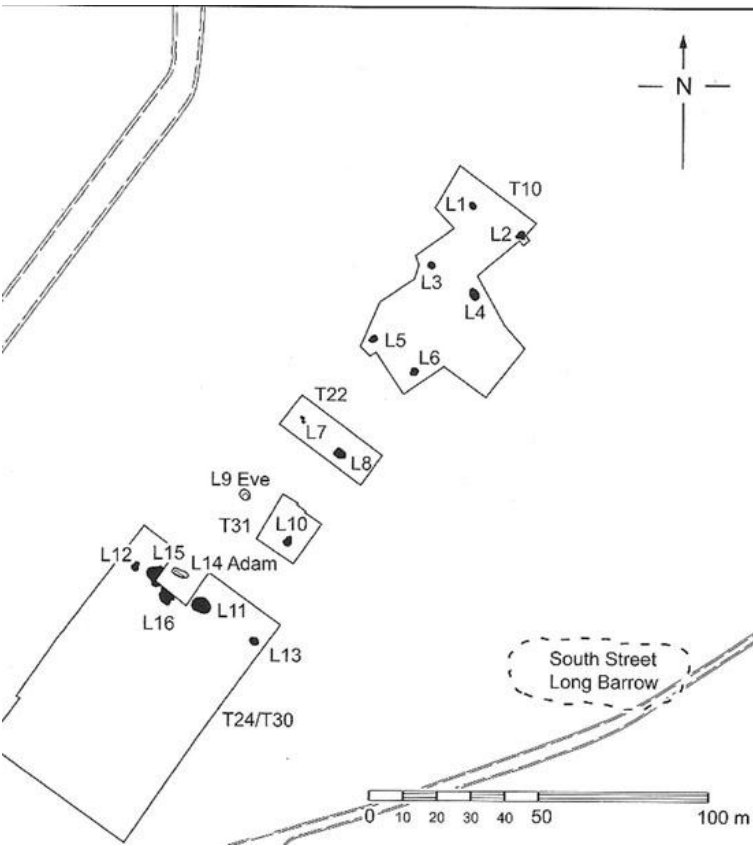
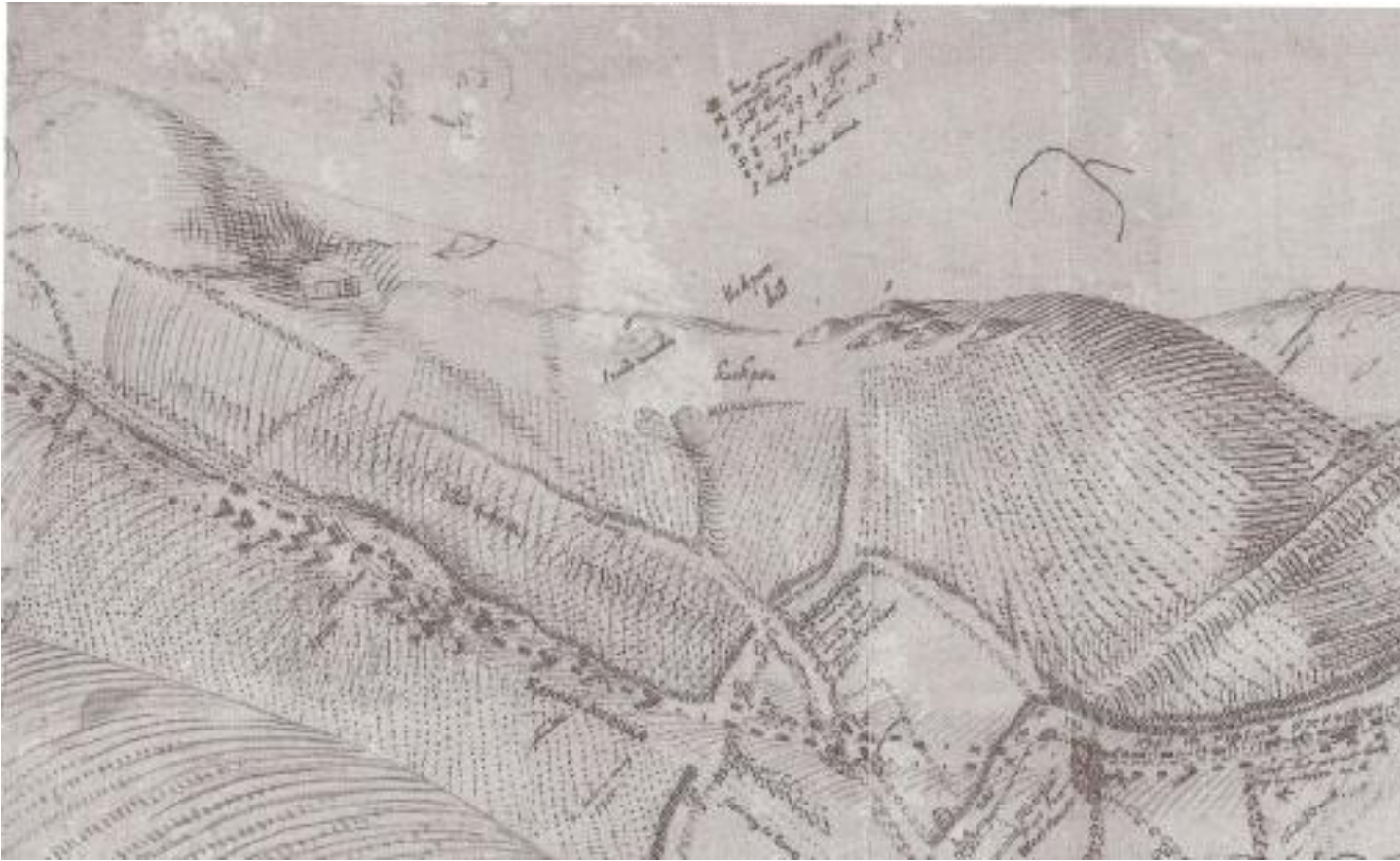


Fig 2.2 'Adam' (L14) seen from 'Eve' (L9)



Fig 3 Stukeley's panorama of the West Kennet Avenue, showing the Cove at the 'apex' to the Avenue (centre left)



(Ucko 199, 191)

The first thing to note is that there is a pattern to the arrangement of stones, and it is only because of this pattern that we can come up with the category 'cove' – either four stones constitute a 'box', as at the Longstones Cove, or three stones form an open 'sentry box' arrangement, as at the centre of the northern inner circle and the West Kennet Avenue cove. They have been compared to the horseshoe arrangement of the sarsen Stonehenge trilithons because of their similarity in scale, their enveloping property, the largest stones at the 'back' of the structure and orientated to the south-west, their central location within surrounding stone features, and the fact that they occur in some of the most complex stone circles in Britain (Cleal et al 1995; Gillings et al. 2008). Therefore, by archaeological classification, a condition of identity is claimed for these structures mainly by the property of a closely organised 'quadrangular' arrangement of stones. Archaeologists have suggested four theories for coves:

1. Seclusion devices nested within the deepest space of surrounding stone circles in which only a select few would have been allowed to enter, and within which rituals would have taken place. (Barrett 1994, 17-18; Burl 1988; Thomas 1999, 214)
2. Stone facsimiles of prehistoric dwellings, in which the cove represent the dwelling's hearth and the surrounding stone circle representing the walls. (Hodder 1982, 224-6; Richards 2005, 218-25)
3. The Longstones Cove is a terminal marker for the Beckhampton Avenue. (Gillings et al. 2008, 71)
4. Sacred space to be inhabited by non-corporeal entities, and from which living humans would have been excluded. (Gillings et al. 2008, 168)

As the three Avebury coves belong to the same monument complex but their design and placement vary, interpretation can be reduced to what is common to all three of them. If there is no common element, then we have weakened the archaeological claim of identity. The first theory may be relevant for the Cove at the centre of the northern inner circle, since it was surrounded by two stone circles, and these would have created a strong seclusion effect within this mass of stones. However, it cannot explain the placement of the Longstones or West Kennet Avenue Coves, both of which are located within and as part of the two stone avenues. A similar point weakens the suggestion that coves are facsimiles of Neolithic dwellings, since no circles of megaliths surround these two avenue coves. The dwelling perspective is also severely weakened by the fact that we have very little evidence for any dwellings at all in Avebury, and hardly any in the whole of the Neolithic in the British Isles. When we do have any evidence, it is then of square houses and round hearths – not round houses and square hearths (Parker-Pearson 2009). The third interpretation that the Beckhampton Cove is a terminal marker for the 'end' of the Beckhampton avenue begs the question of why this form of building is needed to mark a terminus, when the same form also marks the centre of the Avebury northern inner circle while the different form of the Sanctuary, a complex stone and post circle, marks the start/end of the West Kennet Avenue. And as there are good reasons to suspect that the Beckhampton Avenue did not terminate at this position, this claim seems to be loading the Longstones Cove with a meaning external to its own design (Sims 2009b). That a cove might have been a place for 'spirits' or other non-corporeal beings may well seem to fit the first model with the cove as seclusion 'chamber' within nested stone circles, but not for a cove to be located along an avenue with an open side, as was the case as reported by Stukeley with the West Kennet Cove and as was probably the case for the Longstones

Cove. It is far more probable that a cove added some property to the requirements of rituals within an avenue *and* a circle. However, since we know that the soil surface along and *outside* the West Kennet Avenue was more compressed than the soil surface within it (Gillings & Pollard ), then this suggests that the structures were not shunned by the living once they had been built<sup>68</sup>. None of these interpretations can convincingly explain either the form or the placement of coves. This leaves two possibilities - either the category of 'cove' is wrong, or a cove requires other interpretations. If the category is wrong this may be because it is just a 'story' we have invented to signify that we are archaeologists. But as we have not yet exhausted all the properties or locations of coves, realist scholarship requires that we reserve the use of the category and continue with our inquiry.

The suggestion that coves are seclusion devices, whether or not they are surrounded by stone circles, neglects a paradoxical property - they are open at their corners. The corner gaps are substantial – in the order of 2-3 metres for the Avebury Cove in the inner northern stone circle and 5-6 metres for the Longstones Cove – and would have provided minimal seclusion properties. If we are claiming 'seclusion' why have open corners, especially if it is just a three-sided 'box'? Therefore, at best, this suggestion can only be a very partial explanation. Nevertheless, the size of these stones is significant – all three coves are made from very large stones, if not the largest in the entire Avebury complex. They are therefore clearly marking these spaces and their architecture to be prominent in some way. A third property has also been understated – shape. All three stones of the Avebury Cove had straight, vertical sides, flat faces, and lozenge or half-lozenge tops. Aubrey's drawing of the Longstones Cove showed them as having straight vertical sides (Gillings et al. 2008, Fig 2.63), and the one remaining 'Adam' stone is similar to the back-stone of the Avebury cove- a massive stone with straight vertical sides with a half-lozenge top. Gaps with straight vertical sides, rather than a sealed enclosure, are one of the design features of these coves. Rather than considering a cove as a *failed* box, these properties suggest that they are *successful* framing devices, just as the grand trilithon is at Stonehenge (North 1996, Sims 2006). This suggests a fourth property - the plan layout of the Longstones Cove is not quadrangular but trapezoid. The trapezoid arrangement focuses the side stones on the gaps at the corner edges, and adds to the regularity and fidelity of the corner gaps rather than trying to compensate a loosely organised box. This observation may strengthen the earlier parallel drawn with the Stonehenge trilithons – the two stones L16 and L14 (Fig 2.1) funnel the eye from the south-east to the edges of L15,

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<sup>68</sup> Those who walked within the avenue may have about to become spirits.



just as the trilithons draw the eye from the Heel Stone to the grand trilithon when viewing from the Heel Stone. Three further properties of coves have been understated in the interests of classifying them as a separate class or category of monument – their placement within other structures is systematic. The Longstones Cove is placed within the Beckhampton Avenue in a position consistent with the average spacing of all the stones in the avenue. Stukeley's drawing of the West Kennet Cove also places that cove as not separate from the avenue, but integrated within it as another, albeit elaborated, part of the avenue (Ucko et al. 1991, Plate 61). The Avebury coves are not just arithmetical, quantitative, elaborations of other structures in the complex, but they are also geometrically related to them. The Avebury Cove is at the centre of the northern inner circle, and the Longstones Cove is integrated into the western row of the Beckhampton avenue while its axis is orthogonal to the axis of that avenue, and similarly Stukeley reported that the West Kennet Cove was also aligned at right angles across the line of the avenue although now integrated into its eastern row. A circle is defined by its centre and radius, and a line is defined by its length and alignment. All three Avebury coves systematically address by amplification and elaboration the arithmetic and geometric properties of circles and lines. And lastly, each of these coves are also located in carefully chosen landscape positions – the Avebury Circle Cove is placed on the highest part of an undulating ridge that runs through the circle, and while the two avenue coves are on different sides of their respective avenue rows they are both opposite and 'facing' a local, close and high horizon. From these three Avebury coves, the design features found so far are:

1. A tightly organised group of stones,
2. In a quadrangular or trapezoidal plan arrangement,
3. With stones selected for straight vertical sides,
4. And 'flat' faces,
5. With substantial gaps between the 'corners',
6. An axial orientation,
7. In arithmetic dialogue with adjacent megalithic structures,
8. In geometric dialogue with adjacent megalithic structures.
9. The combination of all the above features - flat faces, vertical sides in a tightly organised space viewed from positions within other adjacent structures - 'pinches' precise gaps at the line of sight intersections of these 'corner' stones.
10. Positioned within the local landscape to gain a high altitude near horizon.



## 11. On tops of local ridges commanding views in both directions.

Of these eleven observable features of the three Avebury coves, only the first two were 'noticed' by any of the archaeological theories. This suggests a post-modern critique that the dominant practice within archaeology is to classify prehistoric structures into types of building so that they may be bracketed with other similar structures elsewhere as precedents or facsimiles. From this study of the Avebury coves, it can be seen that separating off these coves from their context throws away elements of their design which connect them to their *adjacent* and *different* structures. If we include these other properties, then a cove is a *component* structure, not a type structure which stands on its own separate from its context. Post-modernism usefully, therefore, can demonstrate how a disciplinary practice constructs classifications that ignore certain features of a thing. On the other hand it does not sensitize us to the different theories and methods that can engage with a fuller list of observations. We have unexplained data for the Avebury coves that is considered 'enigmatic' by archaeology, and which appear to be design features of the cove structures we have considered so far. If we can find another theory or method that notices all eleven and more of these features, then that theory is stronger than those that cannot. If this exercise is successful then it also weakens the post-modern critique of realist scholarship.

An enacted cosmology is a multi-media ritual event. It would include not just depositing selected and processed items of material culture beneath and around built structures, later to be excavated by field archaeology, but the design of these structures would also have aspired to bringing all spheres of their worlds into some sort of coherence – a cosmology. This would have included the above and below this-world transit of cosmic bodies, since all cosmologies and religions share the stricture – as it is in heaven, so it is on earth. Gillings et al. claim that no convincing demonstration has been made for astronomical alignments at coves (Gillings et al. 2008, 169). Before a judgement of 'non-convincing' can be accepted, scholarship expects that this claim is demonstrated by a critique of those who *have* suggested 'astronomical' alignments at coves. Since many archaeologists until recently have not been convinced by the entire discipline of archaeoastronomy, then it may be appropriate to adopt a post-modern suggestion that the professional reticence of archaeology encourages scepticism that is above and beyond scholarship, and that this position is driven largely by the perceived political requirements of a boundary dispute. Three scholars have made such claims – Ruggles (2009), Burl (2002, 147) and North (1996, 271-6). Ruggles points out that coves exhibit a scatter of orientations on lunar

standstill and solstice horizon events, and both Burl and North have suggested that the Avebury Cove has lunar-solar alignments built into its design. Let us first consider North's claim. According to North the Avebury Cove is the focus for two lunar and one solar ray observable from the outer ring of stones looking into centre of the northern inner circle along the tangents of intervening circular structures (Fig 1.2). As both of the centres of the two inner circles stand on an undulating ridge that runs roughly north-south through the main circle, all of these rays when viewed from the outer circle trace their path *uphill*, so framing a clear view of the sky behind - not the landscape. The stones of the outer circle are numbered 1-99 clockwise from the south-eastern entrance. It can be seen from Fig 1.2 that from stone 19 in the outer circle, a ray traces its way through the left hand gap in the back of the cove, touching the edge of the inner circle of the double post circle and then above the outer northeast bank to the northern major moonrises<sup>69</sup>. Moving round the outer circle to the position of stone 65, a ray touches the left hand side of the outer circle of the double post circle, threads its way through the right hand gap at the back of the Cove and then above the outer southwest bank to the winter solstice sunsets. Then around to the position of stones 89/90 of the outer circle another ray at right angles to the winter solstice sunset ray passes the right hand side of the southern inner circle and then along the inner face of the back stone of the Cove beyond the outer bank in the northwest towards the summer solstice sun setting into the summit of Windmill Hill. Notice that all three inner faces of the Cove have alignments on sun and moon and are arranged either in reverse or orthogonally to each other. These are all claims that can be tested by field work, virtual reality modelling, and Monte Carlo random modelling (Macdonald 2009; Ruggles 1999). Also, just as at Stonehenge when walking towards the grand trilithon from the Heel Stone, when walking uphill towards the Cove framing the winter solstice sunset, the upward motion of the observer's eye counter-balances the apparent setting motion of the sun to create the illusion of holding 'time' still (North 1996; Sims 2006).

If this is not an over-interpretation, we would expect to find similar and consistent properties with the Longstones and West Kennet Avenue coves. Turning to the Longstones Cove in Fig 4 it can be seen that as a component of the Beckhampton Avenue, using adjacent avenue stones as back-sights and fore-sights, reversible and orthogonal alignments exist through the corner gaps of the Longstones Cove which

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<sup>69</sup> Lunar standstills occur twice every 19 years and are each spread over the course of about one year. The human eye cannot differentiate the horizon positions of solstice sunrise and sunset alignments for three days either side of the solstice. Therefore there are about thirteen moonsets every sidereal month that define a lunar standstill and seven days of solstice by unaided eye horizon 'astronomy'. (Sims 2006)

continue on to adjacent avenue stones. By combining the published site excavation plan alignments with independent field survey of the Adam stone<sup>70</sup> (see L14 in Gillings et al. 2008, Fig 2.83), we can minimise some of the errors inherent in this exercise. The results are surprisingly in keeping with what our model predicts. The ray to the northeast which threads through the Cove following the line of the western row of the avenue is aligned on the northern major standstill moonrises, the southern major standstill moonsets in reverse, and at right angles to that line a ray continues at an altitude of nearly 3° to the summit of Folly Hill where was once the barrow A2 (Powell et al. 1996, 14) and aligns on the winter solstice sunrise. Therefore, at both the Avebury Circle Cove and the Longstones Cove we have found double horizon alignments on the solstice sun and the standstill moon. These combinations invariably and predictably generate a dark moon coinciding with both the winter and summer solstice sun (Sims 2007).

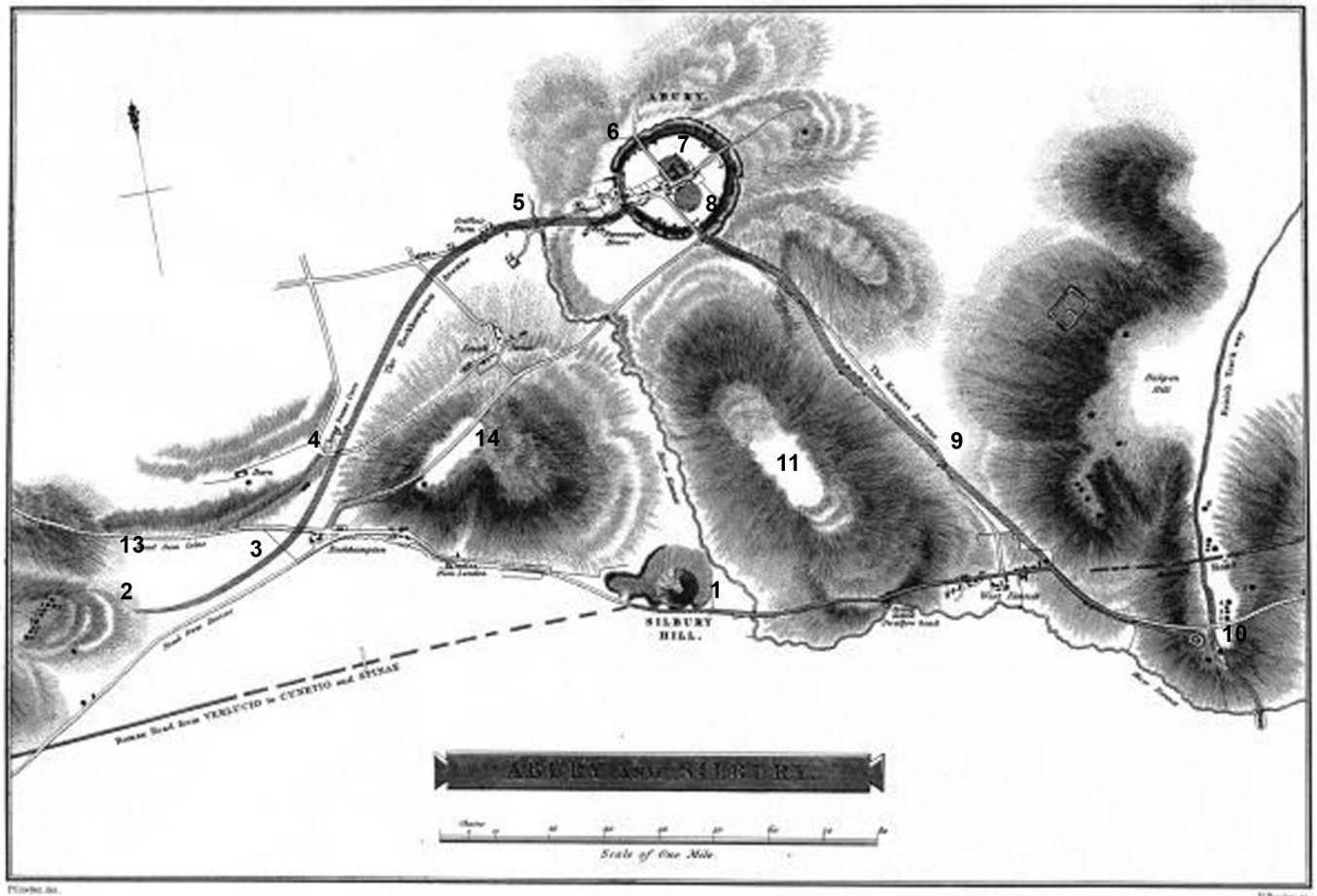
We could have generated the same finding as *predictions* from lunar-solar conflation theory (Sims 2006, 2009). It is a paradox of the Avebury monument complex that the two avenues' routes allow only partial views of Silbury Hill from just five positions, otherwise obscuring all view of Silbury Hill for nearly 80% of their length. Viewing the scoured chalk of the summit platform of Silbury Hill from Fox Covert, the Beckhampton Avenue crossing of the River Winterbourne, the centre of the inner southern circle of Avebury circle, and the Sanctuary simulates seeing the whitish summit platform as crescent moon's first or last glint before and after dark moon at winter solstice (Sims 2009a). From two of these positions, at the River Winterbourne and the Sanctuary, the level summit platform of Silbury Hill is exactly in line with the background horizon. For a viewer that sees Silbury Hill as the moon, by the artifice of building it in the local landscape in line with the background horizon it would signify to them that the moon had set. To see the moon when it has set, then by your own agency this is only possible if you yourself are in the underworld. The monument complex is therefore designed to simulate a route through the underworld. The Beckhampton Avenue 'starts' at Fox Covert moving towards the Longstones Cove with a view of Silbury Hill proud of the eastern horizon (Fig 5). Only the waning crescent moon can be seen rising on the eastern horizon, since it is just to the right of the soon to be risen sun still below the horizon. Once the sun has risen, its light outshines the light of the waning crescent and it can no longer be seen for any of its daytime transit across the sky. Contrarily, the waxing crescent moon is to the left of the

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<sup>70</sup> With thanks to Steve Marshall – personal communication.

sun, and can only be seen setting low on the western horizon once the sun has already set. Waxing crescent moon cannot be seen rising, since the already risen sun again outshines its light. Therefore waning crescent moon is associated with the rising sun

Fig 4 The Avebury complex, with features identified in the text



1. Silbury Hill 2. Fox Covert 3. Beckhampton Avenue 4. Longstones Cove 5. River Winterbourne 6. Avebury Circle and Southern inner circle 9. West Kennet Avenue 10. Sanctuary 11. Waden Hill 14. Folly Hill

and waxing crescent moon is associated with the setting sun. Processing along Beckhampton Avenue from Fox Covert, we are therefore being bracketed with the rising waning crescent moon view of Silbury Hill proud of the eastern horizon. We would predict with this model that along this part of the monument complex any solar alignment would be on winter sunrise, consistent with a south eastern horizon viewing of rising waning crescent moon. In keeping with this prediction, we find that at the base of the northeast side of the Adam stone of the Longstones Cove, a human 'burial' of an adult male had his head pointing to the south-east, in line with the alignment of the Cove towards the Folly Hill barrow complex and winter solstice sunrise. Therefore, both inductively through the data,

and deductively from this theory, we converge at the same interpretation of a lunar-solar conflation of alignments at the Longstones cove. When two different procedures and bodies of evidence converge on the same finding, this exponentially raises our confidence in our interpretation of the observations. They become ‘facts’ for our theory.

We have just Stukeley’s record of the West Kennet Cove, but no recovered site plan. However, since we have found that the other two coves at Avebury are integrated into their building and landscape context, we can predict from the avenue remains and surrounding landscape some of the expected properties of this cove. We risk our model to observational test. From those parts of the West Kennet Avenue which remain in the northern section, viewing across it to the southwest over the crest of Waden Hill the West Kennet Avenue is designed to see the winter solstice sunset across paired stones, and southern minor standstill moonsets across one set of diagonals and cardinal alignments across the other diagonal (Sims, forthcoming). All five burials found along this section of the Avenue are, like that at the Longstones Cove, also on the northeast sides of the stones but for the one of which we have information, his head points to the southwest, consistent with the stone’s alignment on winter solstice sunset. We would expect the West Kennet Avenue Cove, once rediscovered and surveyed, to frame that event with more accuracy than possible with just paired stones and to repeat with greater fidelity the alignments along the avenue to the southeast to frame the rising southern minor standstill moonrises. However, while these are predictions testable by a future site excavation, there is one property we can test now without excavation of the West Kennet Avenue Cove – its horizon views from its known position. Stukeley said that the West Kennet Cove stood at the ‘apex’ to the avenue, and showed that it would have been at position 50a along the modern numbering system for the avenue (Fig 3 and Ucko 1991, 190). This part of the landscape just next to the modern road is a flat saddle between two gentle gullies in the western side of the dry valley. At right angles to the line of the avenue and on the high horizon to the east lies a very large barrow marking the sky-line. But this position, in the middle of the West Kennet Avenue, would have been the first position coming from the Avebury circle where it would have been possible to see the Sanctuary – a complex multiple circle of stones and lintelled posts at the start/terminus of the West Kennet Avenue (Fig 3). From the Cove the winter solstice sun would have risen above the lintelled top of the Sanctuary. Therefore just as the Cove at the centre of the northern inner circle of the henge manipulates an alignment on the summer solstice sunset to also set in the

summit of the causewayed enclosure on the summit of Windmill Hill, so the placement of the West Kennet Cove is in dialogue with views to the northwest towards Avebury circle and to the southeast towards the Sanctuary coinciding with winter solstice sunrise. It is located at the tipping point between a dark moon ritual at winter solstice sunset at the circle and winter solstice sunrise at the Sanctuary. Coves therefore act as focussing devices for horizon 'astronomy', bringing sky and landscape together as a coupled system. Therefore we may add to the list of features for coves:

12. their position in a monument complex is selected to facilitate an arrangement of stones for high fidelity reversible and cruciform lunar-solar alignments;
13. these alignments follow a winter solstice lunar scheduling before, during and after a dark moon ritual;
14. they are located in a landscape position which manipulates the horizon viewing of other structures of different materialities (the chalk and wood of Windmill Hill, mainly chalk, stone and a little wood of Avebury circle, and the equal quantities of stone and wood of the Sanctuary).

Ruggles sees coves' multiple alignments as lacking a 'discernable commonality'. Instead these findings suggest that a dark moon ritual at winter solstice requires a 'grammar' of different alignments for the enactment of an initiatory myth of journeying through the underworld during the longest, darkest night between winter solstice sunset and sunrise. 'Astronomy' and landscape are integrated as a coupled system to facilitate this 'grammar'. Ruggles sees cove alignments as either not stabilising around a single cosmically relevant value or as being aligned on local landscape features distinct from the horizon rise/set positions for the sun or the moon. For Ruggles, this severely limits the archaeoastronomical method. We have found that the Avebury coves do both. This could only be a problem if the assumption were being made that being a 'single' type of structure they 'should' all share the same single alignment. This assumption is consistent with the present archaeological practice of classifying different structures as 'types' which share a common identity, and in the present archaeoastronomical use of the statistical method, which seeks a class of monuments of the same design and expects to 'prove' archaeoastronomy by finding the same alignments for all of them beyond what would be expected by random variation alone. Both disciplinary preoccupations, driven by contemporary political processes internal to the academy, weaken observational and interpretive skills. However, we have found that coves are probably not type structures distinct from their monument context, but that they are *component* structures best

understood by their dialogue with the avenues and circles within which they are located. Therefore mobilising methods for interpreting unique or idiosyncratic structures are more relevant to studying coves than the statistical method. The statistical method may perhaps have been appropriate for a stage of archaeoastronomy designed to overcome archaeological scepticism to the claims of an earlier stage of the horizon astronomy, but it is not subtle enough to deal with coves. It cannot see most of the defining properties of coves, and reflects a political agenda of establishing disciplinary boundaries in the academy. The findings we have made at Avebury appear to be typical of the few other coves known<sup>71</sup>. It is also the case that if we consider the trilithon horseshoe at sarsen Stonehenge as a type of cove, then the lunar-solar double window there amplifies these findings from Avebury, and reduces the number of theories necessary to interpret contemporary monuments of varying designs.

Notice that the full suite of thirteen properties we have found for the Avebury coves will not support a theory such as farming revolution theory which assumes the primitivism of the builders. These structures display a sophisticated syntax of alignments of a lunar-solar and locally marked landscape cosmology. This is consistent with a theory of Palaeolithic/Mesolithic hunter-gatherer respect for the moon which is being confiscated to the novel purposes of Neolithic/EBA cattle herders. This model also fits with the evidence for lunar-solar conflation already found useful to interpret Stonehenge and Silbury Hill - avenue routes and their component coves follow a lunar-solar logic for staging a dark moon winter solstice ritual at Stonehenge and in the Avebury circle which simulates a journey into and returning from the underworld (Sims 2006, 2009a). Critics of this interpretation, whether post-modern or not, must show either that the data is wrong, or that they have a better explanation of the same data. Neither post-modern abstractions nor limiting coves to just a quadrangular arrangement of closely grouped stones will be good enough to encompass all thirteen properties we have found for the Avebury coves.

### **Cultural astronomy – a possible future**

I have utilised the post-modern critique of scholarship to interpret politico-disciplinary motives current within archaeology and archaeoastronomy which impede the interpretation

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<sup>71</sup> It has been reported that the cove at Arbor Low faces the northern major lunar standstill (Alex Whitaker 2009), the cove at Stanton Drew had a very rough alignment to the major southern midsummer moonrise (Burl 1999, Great Stone Circles p.54), Mount Pleasant had lunar-solar cruciform alignments (North 1996, 382), and within Stenness Stones circle the cove's two portals align on the round boss of Maes Howe.

of coves. But I have also argued that there are severe limits to this perspective which fail to account for the patterns within observations. I have adopted a realist theory of knowledge, in which observations can be invested with interpretive meaning once we mobilise relevant theories. I have used an American definition of anthropology as an integrative discipline that links the life sciences and social/cultural disciplines so that we can ask – what is its cosmology? Every discipline and method from biological anthropology, archaeology, linguistics, social anthropology to myth and folk-lore, can then be called upon to reconstruct and triangulate from ancient fragments and modern varieties of behaviour and culture the lost and obscure evidence of all culture's cosmologies. In this paper I have used archaeology, antiquarian testimony, archaeoastronomy and anthropology to mobilise an interpretation of different types of observations. This multi-disciplinary technique does not just 'triangulate' meaning around a single interpretation, but assuming that each set of observations are correct, it only allows a very limited combination of all these elements which recreate the totality of the cosmology of lost cultures. This is the principle of 'emergence'. In this case cultural astronomy is central to enhancing the ability of the other methods in rebuilding the lost reality of coves. Horizon astronomy which sees alignments as a coupled system of landscape and sky can provide the missing ingredient which raises the power of the other methodologies to move towards a deeper interpretation of the cosmologies of the past. Cultural astronomy therefore has a key role to play in interpreting how every culture tries to make sense of 'life' through its 'cosmology'. This paper has argued that this role can only be achieved once scholarship is able to transcend both the post-modern critique and the over-narrow definition of field method current within archaeoastronomy. By adopting a multi-disciplinary approach, or an American definition of anthropology, different methodologies can be brought to bear on any culture's cosmology which, when combined, achieve 'emergent' properties which exponentially reduce the possible number of testable interpretations. This methodology has been demonstrated through a new interpretation of 'coves' which is consistent with a recent 'transformational template' of lunar-solar conflation.

Within archaeology, cultural origins are largely assumed to derive from a Neolithic farming revolution (Thomas 1999). Instead, I have adopted an origins scenario which locates cultural origins amongst low-latitude Palaeolithic hunter-gatherers in Africa. This scenario predicts that the first culture-bearing modern humans synchronised their rituals, and therefore their hunting and politico-sexual lives, according to a lunar time schedule (Knight et al. 1995). Lunar-solar conflation theory is derived from a transformation of this original



lunar template, and which later takes on properties which alienate and adjust lunar properties to an estranging and authoritarian logic of emerging elite cattle-owning males organising within an emerging solar cult. This transformational template fits the circumstances of the builders of the Avebury monument complex, and points one way forward for cultural astronomy's search for a wider vocabulary to interrogate the concept of 'cosmology'.

## NOTES

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**Theoretical sampling of simulated populations at West Kennet Avenue:  
transcending the individualistic fallacy in cultural astronomy by considering  
monument design and landscape phenomenology as coupled systems.**

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The dominant method in archaeoastronomy is to analyse statistically regional groups of similarly designed prehistoric monuments to see whether the 'astronomical' alignments in any of them are not chance occurrences but 'data' (HEGGIE, 1981; HOSKIN, 2001; RUGGLES, 1999). This method cannot demonstrate the intentionality of 'astronomical' alignments for unique monuments – yet structures such as West Kennet Avenue, Stonehenge and Newgrange arguably represent culminating achievements of their prehistoric monument building cultures. The statistical method of Monte Carlo simulation does allow testing unique structures by comparing them to alignments that might occur in a virtual population of randomly generated alternative structures (RUGGLES, 1999; HIVELY & HORN, 2006). But while this removes the need for regional groups of monuments, the method stays at the level of testing the null hypothesis. If we are to interpret the meaning of alignments in unique structures, we need to devise tests not just on the null hypothesis, but also on those hypotheses generated by alternative theories (SIMS, 2009A). This paper suggests another way to overcome the individualistic fallacy is by theoretically, rather than randomly, sampling a simulated population of unique structures within the available local landscape alternatives. This requires considering skyscape and landscape as coupled systems, and allows testing the null hypothesis for intentionality *and* to discriminate between competing theories of the cultural meaning behind alignments. As a case study of these claims, this paper will consider the West Kennet Avenue.

The West Kennet Avenue in Wiltshire, England, was a late Neolithic/Early Bronze Age double row of about 100 pairs of stones between the Avebury circle and the 'Sanctuary' stone and wood circle 2.4km to the south east (Fig.1). Much of the Avenue was either destroyed or toppled as a product of religious intolerance and financial gain in early modern times. The northern section of the Avenue was excavated, surveyed and partially reconstructed before the Second World War by Keiller and Piggot, who showed that the Avenue was a series of straight sections rather than the smoothed 'serpentine' route suggested by Stukeley (KEILLER & PIGGOT, 1936; SMITH, 1965; MORTIMER, 2003). From field survey of the reconstructed Avenue, opposite pairs or their markers are on average 14.7m

apart, adjacent longitudinal pillars or their markers are 23.2m apart, and the average height of surviving stones is 2.26m (SIMS, FIELD NOTES).

In recent papers archaeologists have emphasised power, memory and construction models to interpret the Avenue. Thomas sees the Avenue as a link between structures that enhances their power to manipulate space hierarchically; Pollard and Gillings favour avenues as markers of ancestral trackways and midden sites; Richards sees avenues as 'empty' products of building work that commemorate ancient pathways no longer used (THOMAS, 1991; GILLINGS & POLLARD, 2009; RICHARDS, 2004). None of these models can account for many properties of the West Kennet Avenue. Gillings and Pollard note that the space within the Avenue is littered with a natural spread of sarsen stones close to the surface which would have been hazardous for any procession, and cites this as possible evidence for the 'construction' perspective in which no actual procession ever took place within them (GILLINGS & POLLARD, 2009: 141-2). Yet elsewhere Gillings & Pollard mention that the chalk that runs along and just outside the Avenue, unlike that within the Avenue, is compressed - indicating paradoxically that the inside of the Avenue was not used as an Avenue in the way the memory and power models suggest (GILLINGS & POLLARD, 2004: 91). If we consider both pieces of data simultaneously it undermines all three models, since this suggests that processions did in fact take place *outside and along* the Avenue stones, so providing a changing vista of many stone pillar combinations. It has also become clear that the Avenue was not a continuous row of paired stones as assumed by all three models, but included gaps, omissions and changes in form. For example, Keiller placed a marker at position 30b (Fig. 2) where he calculated a stone ought to be, but noted with some embarrassment that no stone was ever placed in this position (SMITH, 1965: 212; also GILLINGS & POLLARD 2009). Further, the eight 'burials' along this northern section of the Avenue are all on the northeast side of the Avenue stones (SMITH, 1965: 209), suggesting some emphasis on placement and orientation. Without commenting upon it, Pollard has provided data which shows there is a crisscross pattern of deposition of worked flints between Avenue stone pairs 33 and 28 (Fig. 2) and concentrated at position 30b. Each limb of this crisscross regularly alternates between north-south and northwest – southeast (POLLARD, 2005: Fig 10.3). The Avenue is 'partitioned' in two places by placing three stones in line and crossing the Avenue at stones 6b-5a-4b and 15b-16b-17a (Fig.2; SMITH, 1965: Fig. 71; SIMS, FIELD NOTES). For over one kilometre the course of the Avenue along the undulating eastern flanks of Waden Hill (Fig. 1) is approximately parallel to the same 330° orientation as its ridge, so providing a regular, steep and close high horizon

varying in altitude between 5-7°. About 1.25 kilometres to the east lay another high and level horizon which offers an altitude from the Avenue of between 1-2°. Many of the stones have been selected and installed so that their tops, when viewed at the 1.65m eye-height of a Neolithic man (NORTH, 1996: 58) from adjacent or opposite stones, are arranged to coincide exactly with the background horizon. The power model calls attention to the average height of the avenue stones being lower than that of the Avebury circle stones, so displaying according to this model a growing cadence of power from the Avenue to the Circle (GILLINGS & POLLARD, 2004: 18). However, when moving along the Avenue towards the circle from pair 37 to 17 the stones get shorter, not taller, as the power model would predict. The Avenue section between pairs 37 and 17 is within a gentle gulley on the eastern flank of Waden Hill rising up to a saddle between stone pairs 17-13, and the land then falls again towards the southern entrance to the Henge. Only at position 30b (Fig. 2) are the horizons across adjacent or opposite stones of equal altitude. Elsewhere along the Avenue are unequal combinations of horizon altitudes across adjacent or opposite stones. And lastly, viewing from before pair 37 up to position 30, and standing just outside the Avenue on either side, the heights of *all* the stones of the Avenue are arranged to coincide with the background horizon, thus explaining why the stones get shorter when moving uphill towards pair 17. This property is not apparent when standing within the Avenue.

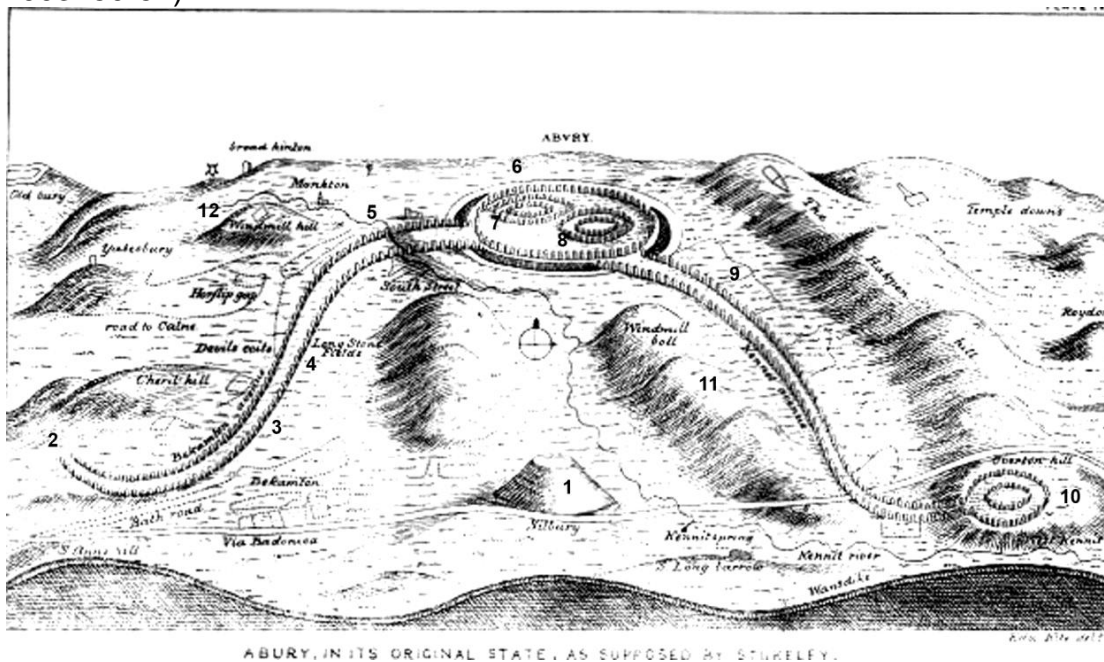
These ten properties of the Avenue suggest themes not accommodated by the power, memory or construction models. First, since the property of the tops of paired and adjacent stones coinciding with the background horizon can only be seen when standing outside the Avenue, this reinforces the inference that internal obstacles to procession and external compression marks should be interpreted as evidence of external processions. This raises the possibility that the tops of these stones are designed to merge with some local horizon event. Second, the crisscross worked flint deposition alternating between north-south and northwest-southeast across the Avenue around position 30b, and the northeast position of the eight 'burials', suggests a linkage between 'death' and 'astronomy'. Archaeologists have commonly reported prehistoric cardinal and cross-cardinal alignments of human burials, and of course this could only have been achieved by some use of 'astronomy' (TUCKWELL, 1975). Third, we have shown elsewhere that the Avenue routes are designed to make Silbury Hill «obscurely visible»<sup>72</sup> – all in order to conduct a dark moon ritual at

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<sup>72</sup> Quote from Stukeley in Ucko et al., 1991: 84.

winter solstice within the Avebury Circle (SIMS, 2009a). As the 29½ 'pair' from the southern entrance to the Avebury henge, position 30b marks the period from one full moon or one dark moon to the next. But 29½ positions from a dark moon entrance bring us to another dark moon. The *absence* of a stone at position 30b, rather than being seen as an anomaly

Fig. 1 Main Features of the Avebury monument complex according to Stukeley (MORTIMER 2003: 50-51).



#### Key

1 Silbury Hill; 2 Start of Beckhampton Avenue at Fox Covert; 3 Beckhampton Avenue; 4 Longstones Cove; 5 River Winterbourne; 6 Avebury Circle and Henge; 7 Northern inner circle; 8 Southern inner circle; 9 West Kennet Avenue; 10 Sanctuary; 11 Waden Hill.

for the power, memory or construction models, is consistent with the lunar-solar conflation model that predicts dark moon symbolism (SIMS, 2007, 2009a). Fourth, the partition of the Avenue by linking in a line three stones that cross the Avenue from 15-17 and 5-7 confirms and adds to this inference, since if position 30b indicates dark moon, then positions 17-15 coincide with full moon and positions 7-5 mark last quarter moon and waning crescent<sup>73</sup>. Two further pieces of evidence can be noted to strengthen this interpretation. The 'burials' along the Avenue are confined to within pairs 29-18 and to stone 5, and are therefore within those lunar Avenue partitions associated with when the moon is dark, waxing or waning *crescent*. And since the horizons across stones from position 30b are equal altitude, this signifies a tipping point along the Avenue that the builders have chosen to signify through the absence of a stone. Fifth, the lines linking three stones across the avenue suggest movement from one side of the avenue to the other, and therefore some

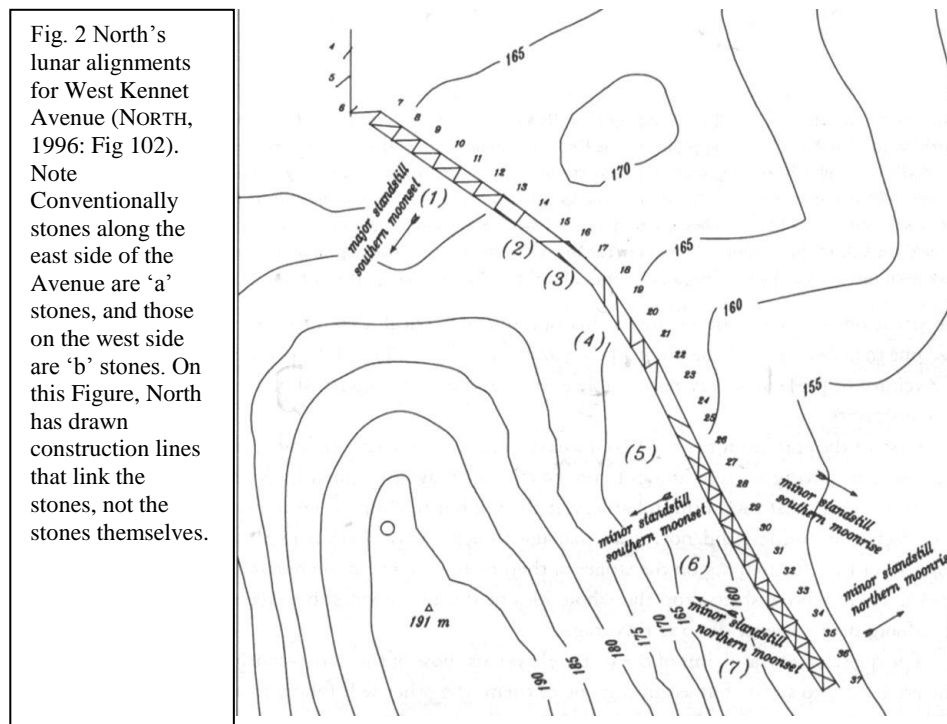
<sup>73</sup> We will see below that the Avenue can be walked in both directions according to the ritual being conducted – hence the number reversal.



symbolic loading to the ‘handedness’ of the route taken along and outside the Avenue stones. Sixth, since the Avebury circle, Silbury Hill and the Avenue routes of the monument complex are partly designed for a winter solstice dark moon ritual, and since we have found grounds for lunar symbolism and alignments integrated into the internal design of the Avenue partitions rather than just its route, then by extension this model would also predict lunar-solar alignments across the Avenue between stones. Seventh, the principle of building structures in line with the background horizon is also seen in constructing Silbury Hill’s summit platform to be exactly in line with the background horizon from two positions prescribed by the Beckhampton and West Kennet Avenues. As Silbury Hill, in its various aspects, is a facsimile of the moon just before, during and just after dark moon, then to observe it in line with the background horizon is an ingenious way to represent the moon when it has set. For a culture steeped in lunar cosmology and sky lore, an observer who can see the moon once it has set can only conclude that she or he must also be in the underworld (SIMS, 2009a). A similar experience is simulated by the device of cross observation of paired and adjacent Avenue stone tops merging with the background horizon. Eighth, the embodied experience of walking *down* into a gulley along a parallel row of stones from position 50 (The West Kennet Avenue cove – see UCKO et al., 1991; SIMS, 2009b) to dark moon position 30b, then uphill towards the full moon position 15, and then downhill again to position 6 and on into the henge, suggests a double simulation of walking into and through the underworld by a *descending* route. If these themes are correct one prediction would be that the West Kennet Avenue would have lunar-solar alignments across paired and adjacent stones that signified solstice dark moon journeys through a simulated underworld.

In what he emphasised was an exploratory archaeoastronomical study of the Avenue, North found lunar and cardinal alignments across paired and diagonal stones, and astral alignments along its length (NORTH, 1996: 252-62). Reworking Thom & Thom’s work, he suggested that there are seven sections between stone pairs 37 and 7 along the northern part of the West Kennet Avenue - all composed of two ideal quadrangular arrangements of stones (THOM & THOM, 1973). The southern sections combined cross alignments in consort with the changing local landscape horizons to provide bearings on the risings and settings of the southern and northern minor lunar standstills, north-south cardinal alignments across one set of diagonals and alignments along the length of the Avenue on stars seen setting on the local north-western horizon. These astral alignments crossed over the positions of human burials alongside Avenue stones. The northern section combined cross

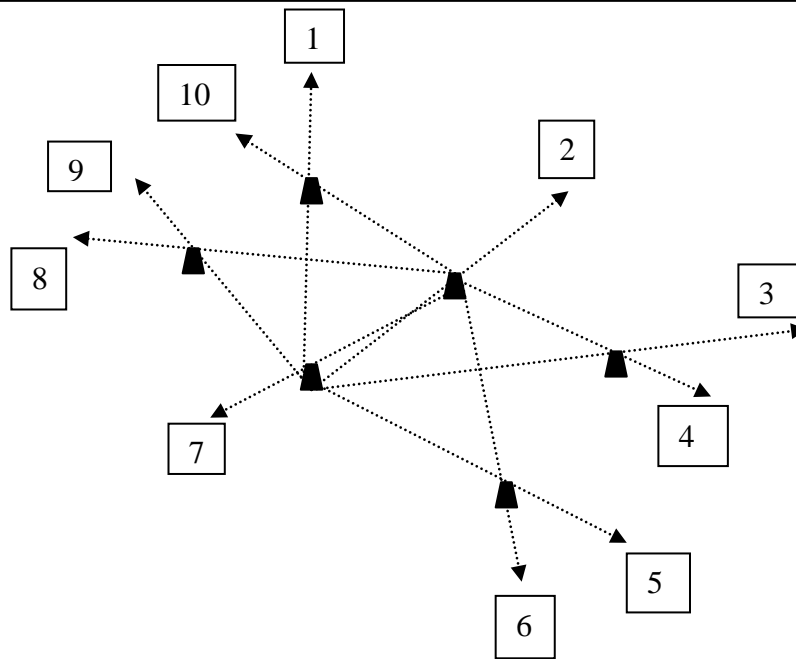
alignments on the setting southern major standstill of the moon, west-east cardinal alignments and astral alignments on the local south-eastern horizon (NORTH, 1996: 252-62). Unlike the artificial landscape created for the Avebury Circle by the henge bank, North argued that the natural landscape of the Avenue's surrounding horizons had been subtly appropriated within its design to achieve transverse lunar, not lunar-solar, alignments (Fig. 2). For John North, this was a continuation with modification of an Early and Middle Neolithic tradition of equal altitude reverse alignments on paired stars across long mounds from their ditches.



A number of observations can be made on this treatment. North actually found 10 sections to this part of the Avenue. In Fig. 2 he shows three additional short zigzag sections between stones 1-4, 4-6 and 6-7 in the Avenue's final approach to the southern entrance of Avebury henge. Rather than seeing this final connection as 'awkward' (SMITH, 1965: 208) or a 'mistake' (GILLINGS & POLLARD, 2004: 78), North's diagram shows that it includes a repetition in diagonal northings which can be found between positions 37-17. Note also that these sections coincide with lunar numeration for the seven days of waning last quarter and three days of dark moon. And building on his findings, these ten sections can also be considered as just three when diagonals are either northings or westings. What is most interesting is that these cardinal alignments coincide with sections we have found where three stones cross the Avenue in a straight line, and which also coincide with the

phases of the lunar synodic cycle. Further, the three in-line stones are themselves northings and westings, which are also joined to transverse diagonals of the next section, so emphasizing at the jointing pairs that these are Avenue turning points<sup>74</sup>. Each of these five properties reinforces the others.

Fig. 3 The ten possible orientations from any pair of stones to adjacent pairs



North adopted Thom & Thom's method of considering the stones as points, claiming that looking south, North's section one of the Avenue (Fig. 2) was aligned on rising Sirius and Rigel, and looking north from section seven on setting Capella. Accepting these alignments requires tolerating dates that span nearly six centuries, from 2320-1750 BCE. Since the dates we have suggest the Avenue was built in the last quarter of the third millennium (GILLINGS & POLLARD, 2004: 76), these astral alignments are problematical and we will set them aside. For lunar alignments, across the Avenue in sections 6 and 7, he found alignments on the southern and northern minor standstill rises and sets combined with diagonal northings, and in his section 1 on the southern major standstill moonsets with diagonal westings. He argued that the builders had devised an ideal ratio of quadrangular pillar gap length to width of the Avenue which, when located close to the high ridge of Waden Hill, pulled-in the range of the moon's transit to allow combining it with cardinal alignments. He did not provide his data points for all possible combinations of paired and adjacent stones, and presented his results in a schematic way such that it is difficult to know precisely which alignments for which stones were being claimed. North was very cautious in his claims, noting that problems were posed by the accurate

<sup>74</sup> Table 1: row 7 column 8 and row 6 column 1; row 16 column 8 and row 17 column 1.

determination of stone positions after millennia of abuse, that the stones were too close together for accurate determination of sightlines, that we cannot be sure how they determined alignments across the different stone shapes, and that very few stone tops cut the horizon to provide a precise horizon foresight (NORTH, 1996: 257). The caution was in keeping with the assumptions built into 'the Thom paradigm', which claims and expects very accurate astronomical horizon alignments. North was ambiguous in his engagement with 'the Thom paradigm' since, along with Burl and Ruggles, he also argued for a 'religionist' explanation of prehistoric horizon 'astronomy' that does not require extreme precision (BURL, 1987; RUGGLES, 1999). He applied this second view to the West Kennet Avenue, and agreed with Keiller, Piggot, Smith and Burl that the claimed alternation in stone shape between pillar and lozenge fits a fertility theme of male and female, and this is consistent with the solely lunar set of alignments he found. But since no such alternation in stone shapes exists (SIMS, Forthcoming) it removes or complicates such a proposal. Nor does it fit his main finding that an early Neolithic engagement with winter alignments on paired stars at the long mounds was superseded in the late Neolithic/EBA by monuments which paired lunar and solar alignments, not solely lunar alignments.

The route out of these conundrums is through the detailed and correctly specified properties of the Avenue itself, combined with close attention to the assumptions of the models we are using. North showed that around 3,625BCE the West Kennet Long mound allowed viewing from its northern ditch and looking south over the mound the star Sirius rising above of the burial chamber, apparently walking along the top of the mound, before sinking back into the mound as it set. In reverse direction and at an equal altitude when looking from the southern ditch, the circumpolar star Arcturus descends and apparently walks along the top of the burial chamber, and then rises up into the heavens (NORTH, 1996: 72-85). This is a 'religionist' appropriation of an axial connection between the underworld and the heavens at the point where the illustrious dead are 'buried'. A degree of accuracy is required to construct the illusion, but it is driven by a religious logic - not to meet the standards of some abstract prehistoric science<sup>75</sup>. If North is saying the West Kennet Avenue is a modified continuation of this tradition, then the fact that the closely spaced Avenue stones do not cut the horizon may be a problem for the Thom paradigm's predilection for accurate distant horizon markers, but it is an advantage for religiously investing them with their background horizon alignments on the risings and settings of cosmic bodies in their journeys into and out of the underworld. Further, to suggest each

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<sup>75</sup> This is not to say that a religious logic cannot release a dynamic which might later become 'abstract'.

cell of four stones fitted an ideal quadrangle would see deviations from the ideal as 'error', and this would tie the method to one set of, in this case, lunar expectations. It would be a more robust procedure if we just let the data speak for itself and measure the significance of any of the actual Avenue stone's layout as it fails to meet hypothesised 'ideal' dimensions against their individual horizon effects. Instead of using the quadrangle as the unit of selection, we will use the stone pair, since this allows for changes in spacing between pairs along the length of the Avenue. To follow this procedure immediately leads to a very different appreciation of the data. The horizon aperture of closely spaced large stones whose tops coincide with the background horizon is large. The observer's eye might be looking from the left or right side of the back-sight stone and to the right or left of the foresight stone, and still the effect would be the illusion of a cosmic body emerging out of or descending into the top of the stone. But then, the religionist hypothesis predicts that this would be one 'astronomic' property the builders sought, so the large range afforded by closely placed stones for viewing such an effect would be *intentional and advantageous*, albeit contrary to the expectations of the Thom paradigm. Viewing across the different sides of paired stones gives an average deviation of  $11^\circ$ , and for diagonals  $5.5^\circ$ . Since the angle of separation between solstice and standstill alignments is nearly  $10^\circ$ , we will use a margin of  $5^\circ$  as a criterion across stones to discriminate between particular alignments. And as the property of stone tops coinciding with the background horizon can be found for any of the ten possible combinations of adjacent stones for any pair of stones (Fig. 2), by field survey we can calculate the combined effects of azimuth and horizon altitude for all ten of their possible combinations. The same bearings can be taken across concrete markers, and all are shown in Table 1.

The 167 alignments that have been found in the Avenue support our initial hypothesis that processions did take place, but they can only be appreciated from outside, not inside, the Avenue. Second, the alignments are not just lunar, but lunar-solar – which is consistent with our prediction that lunar alignments alone are insufficient to specify a dark moon ritual (SIMS, 2007). Third, the Avenue is partitioned at exactly the sections we predicted by a switch from northings to westings at full moon positions 15-17 and from westings to northings at last quarter moon at positions 5-7 respectively, also confirming our hypothesis that a system of lunar numeration by stone position was being followed by the builders. This is reinforced by both northings and westings being combined at the 'focal pairs' of these partitions. Fourth, these alignments are settings and risings in both directions, but they themselves are partitioned according to the Avenue lunar phase section. In Table 1 it

can be seen that lunar, solar and cardinal alignments within each section specified the handedness and direction of travel from outside the paired stones:

1. Travelling north along the Avenue from stone pair 37 up to the full moon marker around stone pair 15, the Avenue can be walked from its western side viewing alignments to the north across diagonals and to the northern minor standstill moonrises and occasionally summer solstice sunrises across pairs (Cols. 1 & 2).
2. The same section can also be walked in the same direction but now from the eastern side where the alignments are solely along diagonals on the northern minor or major moonsets and occasionally the summer solstice sunsets (Cols. 7 & 8).
3. Once past stone pair 15 along to pair 7 and continuing northwards, alignments across the Avenue can *only* be seen by walking from the east side, where diagonals are now to the west and paired stones are aligned on winter solstice sunsets and the southern major standstill moonsets (Cols. 7 & 8).
4. Along the *line* of the Avenue and still travelling north, unlike earlier when no alignments were specified, it is now aligned on the northern major and minor standstill moonsets and the summer solstice sunsets (Cols. 9 & 10).
5. From pair 7 to pair 1<sup>76</sup>, alignments can be seen from both sides of the Avenue (Cols. 1, 2, 7-10). From 7-4, diagonal alignments switch back to north, paired alignments alternate between northern minor moonrises and summer solstice sunrises, and diagonal alignments to the northern major moonsets. From 4 to 1 alignments switch again to west, and to the southern minor and northern minor and major moonsets.
6. Now changing direction and travelling south along the Avenue from pair 1 to pair 7, alignments can be seen from both sides (Cols. 2-7). From 1 to 4, a westing is combined with northern and southern minor and major risings, and the southern minor settings, and from 4 to 7, on northern combined with winter sunrises, southern major risings and settings and winter sunsets.
7. Still travelling south along the Avenue from pair 7 alignments continue from either side of the Avenue, whose *line* is on winter solstice sunrises and southern standstill moonrises (Cols. 4 & 5).
8. Walking on the west side from pair 7 diagonal stones are aligned on east but there is just one summer solstice sunrises alignment (Col. 3), and walking on the east

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<sup>76</sup> The section from pair 4 to pair 1 poses particularly difficult field work problems. It was nearly completely destroyed by the modern road, the henge bank horizon was modified in the late eighteenth century, and we only have Keiller's incomplete excavation notes to go on.

side there are many paired alignments on winter solstice sunsets and the southern major standstill moonsets (Col. 7).

9. Continuing south, once past the full moon marker at position 15 only very occasionally is the length of the avenue aligned on the southern standstill moonrises (Cols. 4 & 5), hardly any alignments on settings can be seen from the eastern side (Cols. 6 & 7), and there is a very strong emphasis on viewing winter solstice risings and southern minor and major moonrises across the Avenue when walking on the western side (Cols. 2 & 3).

Focusing on just the main long sections of the Avenue, there is a marked lack of southern setting alignments when processing south along the east side of the Avenue past the full moon position 15 (Table 1, columns 4-7), just as there is a marked lack of northern risings when processing north along the west side of the Avenue between sections 15 and 7 (Table 1, columns 1-3). The finding that in the approach to the Avebury Circle downhill from 15-7 only settings can be observed reinforces an earlier suggestion that one purpose of the Avebury Circle was to time rituals on the longest darkest night – when winter solstice sunsets coincide with the dark moons of southern minor and southern major standstill moonsets (SIMS, 2009). Contrarily, in the approach to the Sanctuary from 15-37 only risings can be observed, and this suggests by the same logic that one purpose of that monument was to time rituals at winter solstice sunrise with the southern standstill moonrises. Therefore travelling south over the saddle location of stone pair 15 the prescribed view across the stones is on winter solstice sunrises and the northern and southern minor and major standstill moonrises, and travelling north away from pair 15 the view across the stones is on winter and summer solstice sunsets and the southern major and northern minor moonsets.

We need to take note of some of the implications of this handedness of the processional routes. It is interesting that when travelling southwards from stone position 14 and onwards the top of the Sanctuary could have just been seen peeping around the edge of Hackpen Hill, and when travelling northwards from stone position 15 the top of Windmill Hill and the outer bank of the Avebury Circle and the top of the tallest central stone can be seen. Since southings cannot be observed when travelling south on the west side of the Avenue, and since eastings cannot be observed when travelling north on the eastern side of the Avenue, then this narrows the prescribed views to northings in sections 15-37 and 7-4 when travelling north and westings in section 15-7 when travelling north. All these points add weight to the significance of the crossing lines of three stones at the 'lunar

junctions' at positions 6 and 16 along the Avenue, and further confirm our interpretation that the Avenue was designed for processions to take place outside the paired stones. Looking at columns 2, 3, 7 and 8 in Table 1, the cross Avenue alignments for walking south on the western side of the avenue and walking north on the eastern side of the Avenue respectively, notice that the dominantly lunar alignments are interspersed with the occasional solstice alignment. The deviations in Avenue dimensions and direction required to achieve these combined lunar-solar alignments, rather than being seen as by John North an 'error' in achieving some lunar-cardinal quadrangular ideal, is here revealed as design for conflating lunar and solar sightlines in the 'same' Avenue direction and combined with cardinal alignments. This combination of solstice and standstill alignments in the same direction, an 'identity' pairing, always predictably generates dark moon at that solstice (SIMS, 2007). This is repeated when walking north along the western side of the Avenue between stones 37 and 14. Column 2 in Table 1 shows cross alignments on dark moon at summer solstice combined with, as shown in column 1, a very strong emphasis on north.

To find 167 alignments across 37 paired stones or their markers in ten differently aligned straight sections is beyond what we would expect by chance alone<sup>77</sup>. Since the null hypothesis cannot explain these alignments, then it remains to devise tests for those theories which aspire to do so. The alignments we have found do fit a pattern predicted by lunar-solar conflation theory. But it may be the case that the same data also confirms the power, memory and construction models, or even other archaeoastronomical theories, so allowing multiple interpretations of the same data. Instead of testing each of these models against a random sample of chance arrangements and alignments, all of these models can be tested against their landscape and skyline context by theoretically sampling properties of both dimensions considered as a coupled system. The power model interprets avenues as processional routes that link existing buildings to enhance their ability to hierarchically manipulate space. Therefore the West Kennet Avenue's route between the Sanctuary and the larger Avebury Circle is seen to present participants with increasingly larger stones as they are progressively revealed behind nested facades. This model however admits of just two constraints – a start point at the Sanctuary and an end

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<sup>77</sup> If we round the average of each Avenue section to four paired stones, on average they generate nearly 37 possible alignments each, taking into account the two end pairs smaller number of possible alignments. As each alignment span is 5°, the two central pairs could possibly converge with alignments that cover a total range of 80° (12 lunar-solar and 4 cardinal) and the two end pairs a range of 60°. An average total range of 76° gives a 76/360, just over one fifth, chance of hitting an alignment by chance. But since 16.7 average alignments are found for each of the ten sections, rounded to 17, this signifies that we have found 17 actual alignments out of 37 possible – just under one half. This is far more than can be accounted for by accident alone.



point at the Avebury Circle. It cannot account for why the actual Avenue route passes within 100-200 metres of two other contemporaneous buildings – the small Falkner's

Table 1 Alignments of West Kennet Avenue stone pairs 1-37 with adjacent and opposite stones.

Comb: Pair	1	2	3	4	5	6	7	8	9	10
1								NMajS		
2			SMinR					NMinS		
3				SMajR		South	SMinS			NMajS
4		NMinR	South				WEST			NMajS
5			SMajR			South		North		
6	North						WSS	NMajS		
7		SSR		WSR	WSR		SMajS	West	NMinS	NMinS
8			East	SMinR	SMinR				SSS	SSS
9			East	SMinR	SMinR		SMajS	West	NMinS	SSS
10				WSR	SMinR		WSS		SSS	SSS
11			East		WSR		WSS		SSS	SSS
12			East	SMinR	SMinR		SMajS	West	SSS	SSS
13				WSR	SMajR		SMajS	West	NMinS	NMinS
14		NMajR		WSR	WSR		SMajS	West	SSS	NMinS
15		NMajR	East				WSS	West	NMinS	NMinS
16		NMajR				South	WSS	West		
17	North	NMinR	SMinR	SMajR	SMajR	South			SSS	
18	North	NMinR	SMinR			South			NMajS	NMajS
19	North	SSR						NMinS		
20	North	SSR	SMinR			South	SMinS	NMinS	NMajS	
21	North	NMinR	WSR	SMajR		South		NMinS	NMajS	
22	North	NMinR	SMinR			South		SSS	NMajS	
23	North	NMinR	SMinR			South		SSS		
24	North	NMinR	SMinR					NMajS		
25		NMinR	SMinR					SSS		
26		NMinR	SMinR					SSS		
27		NMinR	SMinR					NMajS		
28	North	NMinR	SMinR					NMajS		
29	North	NMinR	WSR					SSS		
30	North	NMinR		SMinR				NMinS		
31			WSR					SSS		
32		NMinR						NMajS		
33	North	NMinR	SMinR					NMinS		
34	North	NMinR	SMinR					NMinS		
35					SMajR			NMinS		
36	North	NMinR	SMajR	SMajR				SSS		
37	North	NMinR	SMinR	SMajR	SMajR			SSS		

### Note

For any pair of stones with adjacent pairs on either side, the ten possible combinations of pairings from the central pair to all six stones are shown in Fig. 2. These combinations are numbered clockwise 1-10 as azimuths from North starting at the northern diagonal and are the column headings in this table. The row headings identify the number of the stone pair positions 1-37. The azimuth bearings for zero horizon altitude at this latitude of 51° 25' for lunar standstills, the sun's solstices and cardinal alignments (not to be confused with equinoxes) are: North 0°/360°; Northern Major standstill moonrise (NMajR) 40.5°; Summer Solstice sunrise (SSR) 48°; Northern Minor standstill moonrise (NMinR) 59°; East 90°; Southern Minor standstill moonrise (SMinR) 121°; Winter Solstice sunrise (WSR) 129°; Southern Major standstill moonrise (SMajR) 141.5°; South 180°; Southern Major standstill moonset (SMajS) 218.5°; Winter Solstice sunset (WSS) 231°; Southern Minor standstill moonset (SMinS) 239°; West 270°; Northern Minor standstill moonset (NMinS) 301°; Summer Solstice sunset (SSS) 312°; Northern Major Standstill moonset (NMajS) 320.5°.

Stone Circle in the middle of the valley, and the massive West Kennet Palisades at the point where the Avenue turns north to enter the dry valley which leads to the Avebury Circle – but does not link them all up. If power is mobilised by linking monuments, why

does the West Kennet Avenue ignore two equally sized monuments also on the same course? There are eight other possible two or three monument combinations that the Avenue might link between these four structures, and none of these are accounted for by the power model. Clearly, the builders saw some categorical distinctions between these structures which required some to be linked by the West Kennet Avenue and some not. These distinctions, however, are beyond the explanatory abilities of the power model. The memory model argues that the Avenue commemorates ancestral route-ways into the region, as revealed by ancient midden sites. We can test this model by theoretically sampling the topography of the valley. In transect the dry valley profile is of a roughly symmetrical flattened 'U' shape. The route of the West Kennet Avenue through this valley is decidedly odd, especially if looked at from the point of view of an ancestral Mesolithic hunter. The Avenue 'starts' at the Sanctuary at a height of 167 metres above sea level, then drops quite steeply down to cross the valley floor just below 150 metres, to then climb halfway up the other valley side to take an undulating route along the western side of the valley at about 160 metres. No experienced walker, let alone ancestral Mesolithic hunter, would willingly lose height to then have to so quickly regain it. This is especially so when it is noticed that the Sanctuary is located on the top of a ridge that extends along the eastern side of the valley occupied by the Avenue, and which would have afforded a perfect route overlooking the whole valley and still end up in the area where the circle came to be built. This reasoning is not weakened by the archaeology of the area, which provides evidence of Mesolithic remains in the valley that subsequently became the route for the Beckhampton Avenue, but none whatsoever for the valley of the West Kennet Avenue (ALLEN, 2005).

Tests for meaning, compared to tests for the null hypothesis, can also be applied to our lunar-solar conflation model of the West Kennet Avenue. What is very interesting about the West Kennet Avenue is that by crossing the valley it hugs close to steep local horizons on one side of its route. After descending from the 'start' of its route from the Sanctuary it has a high horizon of about 5° to the northeast and a low horizon of about 1.5° to the southwest, and at its 'end' along the section we have studied it has a high horizon of about 7° to the west and a low horizon of about 2° to the east. If the builders had chosen other routes through the valley, it could have been arranged for either equal altitude horizons of about 2° either side of a middle route through the valley, or it could have reversed the 'gearing' of horizon altitudes either side of stones 37-1 with 7° to the east and 2° to the west for a route along the eastern side of the valley. The significance of these landscape

properties for 'astronomical' alignments is significant, since by choosing one particular route they selected for a particular portfolio of possibilities. For every  $1^\circ$  increase in horizon altitude, the azimuth of any particular horizon rise or set position at this latitude ( $51^\circ 25' \text{ N}$ ) is reduced by about  $2^\circ$ . Therefore an eastern horizon of  $2^\circ$  will reduce risings by  $4^\circ$  and a western horizon of  $7^\circ$  will reduce settings by  $14^\circ$ . A gearing in azimuths of  $10^\circ$  between western and eastern horizons either side of the Avenue matches approximately the difference in azimuth between lunar standstill and the sun's solstice alignments. This provides the opportunity to have paired reverse linear alignments with a solstice alignment in one direction and lunar standstill alignment in the other. Columns 2 and 7 in Table 1 show that the builders chose not to utilise this given property of the local landscape. They selected for alignments on cardinal directions on one set of diagonals (Cols. 1 & 8 in Table 1), lunar and occasionally solar directions on cross pairs and the other set of diagonals (Cols. 2, 3, & 7). The meaning behind these alternatives is that a reverse pairing of lunar standstill and a solstice alignment predictably generates a full moon to coincide with the solstice sun, whereas a paired alignment of identity in which both sun and moon alignments are along the 'same' alignments predictably generate a dark moon to coincide with the solstice sun. Instead the builders chose to use the same property of the horizon gearing of alignments to partition combined alignments on moon, sun and cardinality according to handedness, direction of travel and sight of the destination monument. This new test, which sees the local landscape as a region of alternatives, allows us to conclude again that the builders therefore designed the West Kennet Avenue to time rituals at the Avebury Circle and Sanctuary which coincided with dark moon at respectively winter solstice sunset and sunrise. This arrangement of combined alignments is true for all combinations except two – those for stone pairs 15 and 16 combine the northern major moonrises with the winter solstice sunset (Table 1, rows 15 and 16 & columns 2 and 7). These reverse alignments across these two stone pairs utilize the horizon gearing across the Avenue to do what is precisely avoided along the rest of the Avenue – predictably generate a full moon at winter solstice. This re-confirms our original claim for a lunar numeration coded into the Avenue within which position 30b and pair 1 symbolise dark moon, and position 15 full moon.

We have found that the West Kennet Avenue was a changing vista of stones across which pairs and diagonals were optimally arranged for their tops to be level with their background horizons at points which coincided with the rising and setting solstice sun, standstill moon and cardinal directions. These arrangements allow the stones to be constructed as portals

to and from the underworld and invest them with heavenly order. Human remains of boys and men, some of whom bear ante-mortem long bone cut marks and post-mortem violent symbolism (SMITH, 1965: 209-10), are located along stones which are not associated with full moon or gibbous waning moon – namely the times when moon transits through the night-time sky – but with dark moon, waxing new moon, and waning crescent moon<sup>78</sup>. All of the skeletons are on the north-east side of stones between stones 18-29, and along that part of the Avenue we have found that when walking south it can only be walked on the west side to view winter solstice risings and southern minor and major standstill moonrises. Handedness is therefore built into the ritual procession, where blood, death and resurrection are on the left *concealed* side of those processing towards the Sanctuary (HERTZ, 1960). This suggests a categorical distinction between monuments linked to a processional round, in which winter solstice *sunset* dark moon rituals were conducted at the Avebury Circle and, once completed there, the West Kennet Avenue provided the link to winter solstice *sunrise* dark moon rituals to stage the next part of this cosmology at the Sanctuary.

These interpretations of the ethnographic meaning of the West Kennet Avenue have been reached by considering evidence from archaeology, archaeoastronomy and landscape phenomenology. These three disciplines have not been triangulated but *integrated* by finding what new properties emerge when we test them against alternative structures that could have been made by the builders within the same landscape. By considering landscape, material culture and skyline as coupled systems, and by theoretically sampling how they might have been combined, it is possible to discriminate between the models researchers are presently using to interpret unique prehistoric monuments such as the West Kennet Avenue. This has allowed us to cancel many of the anomalies in present archaeological models for the Avenue by one over-arching model of lunar-solar conflation. By my count 14 design details of the West Kennet Avenue, which are anomalies for the extant models, are cancelled by the model of lunar-solar conflation: processions outside rather than inside the Avenue; stone tops coinciding with background horizons; stones missing by design; burials cross-cardinally aligned; zigzag cardinally aligned flints focused on a gap in the Avenue; avenue partitions marked by three cardinally in-line stones that cross the Avenue; an Avenue that clings close to local high horizons; stone heights installed as a *section* to match local horizons; a route that synchronises with lunar partitions to descend when approaching dark moon signifiers; a point of equal horizons

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<sup>78</sup> Of course waning crescent moon cannot be observed for the first half or more of the night.

across Avenue stones chosen as partition break; the use of 'handedness' to signify ritually marked experience; Avenue direction changes synchronising with lunar phase; northings and westings combined at the linking pairs between partitions; alterations in Avenue cell dimensions departing from some imposed 'ideal' to allow lunar-solar combined alignments. These 'anomalous' details can all be explained by a religionist archaeoastronomy of lunar-solar conflation.

Three features remain unexplained: the meaning of northings and westings; the zigzag pattern of deposition and alignments; and the significance of changing inter-visibility between monuments along the length of the Avenue. Our use of theoretical sampling has drawn from Avenue design details, landscape and 'astronomy' as coupled inputs. More inputs from different domains are required to attempt an interpretation of these three remaining 'anomalies'. More extensive burial data, further cases of material culture designs incorporating zigzag motifs, and a detailed study of the Sanctuary itself need to be brought to bear on these features of the West Kennet Avenue to search for the emergent properties which will allow narrowing the range of possible explanations. One new feature emerges. We have previously argued that to simulate a journey through the underworld requires walking from west to east along Beckhampton Avenue to the Avebury Circle and then on along the West Kennet Avenue to the Sanctuary (Sims, 2009a). But this paper has found that it was also ritually prescribed to walk along the West Kennet Avenue in the opposite direction - from east to west. This property will require further study by investigating the properties of lunar alignments.

Re-examining North's exploratory study of the West Kennet Avenue has been a fruitful exercise. His suggestion that its design was a continuation with modification of an Early Neolithic long barrow tradition of reverse equal altitude astral alignments has been strengthened, but only by revising some of his key assumptions. Using the stone pair rather than stone quadrangle as the unit of data organisation has revealed that small changes in Avenue direction and stone spacing allows combining lunar *and* solar alignments across the Avenue. Studying the implications of the West Kennet Avenue's route hugging close high horizons, we have discovered how the builders manipulated 'astronomical' knowledge by gearing lunar, solar and cardinal alignments. And mapping the pattern of alignments in detail has shown the 'handedness' of alignments which prescribes the direction of travel between the Avebury Circle and the Sanctuary. In so doing they constructed a route through their local landscape which ingeniously simulated

a journey through a virtual underworld to take them to initiatory 'death' at the Avebury Circle and 'resurrection' at the Sanctuary.

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## **Which way forward for archaeoastronomy? West Kennet Avenue as a test case.**

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### **Abstract**

Since the 1980's archaeoastronomy has established rigorous field work methods and scientific procedures that guard against the over-interpretation of prehistoric monument alignments that characterised the discipline in preceding decades. However, the discipline still has to embrace those procedures that can interpret unique monuments rather than just regional groups of monuments, and to interpret a growing data base which includes many combined alignments on lunar standstills and the sun's solstices. These hesitations seem to flow from a reticence to provoke an otherwise sceptical archaeology establishment. This paper argues that archaeoastronomy can perform an invaluable function with four-field anthropology (archaeology, social anthropology, biological anthropology and linguistics) as a keystone discipline within such a multi-disciplinary arch. The paper demonstrates such a role through a critique of the present archaeological interpretations of the paradoxical approach of the West Kennet Avenue to the Avebury circle and henge in Wiltshire, England. It finds that the archaeology of cattle-herding monument building cultures and the anthropology of brideprice subverting brideservice can be synthesised with the archaeoastronomy of lunar-solar combined alignments to confirm an emergent model of an elite cattle-owning male-dominated cosmology which both continues and displaces an ancient lunar-governed hunting and gathering ritual system onto a solar timescale.

### **Keywords**

Archaeoastronomy; archaeology; anthropology; West Kennet Avenue; lunar-solar; brideprice; emergence.

### **1. Introduction**

Over the last 40 years archaeoastronomy has successfully transcended the shortcomings of the work of Hawkins and Thom (Heggie 1981; Ruggles 1999). It has rebutted claims for

the over-interpretation of monuments' alignments by establishing rigorous field work methods and the statistical analysis of regional groups of monuments, so establishing that many prehistoric monuments have 'astronomical' alignments intentionally built into their design. In Europe these gains have been made in spite of a largely sceptical archaeology establishment. However, such has been the strength of this scepticism that archaeoastronomy has settled into a narrow routine seemingly in an effort to gain wider acceptance. While providing a way to reject the null hypothesis, the statistical approach cannot be used for testing intentional alignments in unique monuments such as Stonehenge or the Newark Earthworks. This leaves the field open for other disciplines to monopolise such unique and defining monuments at the expense of any archaeoastronomical input. Yet at least four other methods are available that can interrogate individual monuments. Monte Carlo modelling constructs a virtual population of randomly generated alternative 'unique' structures which allow statistically testing for the null hypothesis (Hively & Horn 2006; Ruggles 1999). Isolating detailed features of a monument that are unexplained by other hypotheses allows testing for an astronomical property (Ruggles 1999; North 1996; Sims 2006). A quantified landscape phenomenology looks at the landscape context of any monument as a region of alternatives, so facilitating tests for whether the actually chosen site exhibits any particular portfolio of properties which may include an 'astronomical' dimension (Sims 2009). And virtual modelling of monuments within accurate computer models of landscape and skyline provides another test (Macdonald 2007). These five methods constitute a significant battery of techniques to test the null hypothesis for intentional alignments for both regional groups and individual monuments.

The discipline has also become characterised by an inclination to seek single axial alignments for any one monument, and to define the builder's cosmology as limited and defined by that single alignment. Thus a regional group with axial alignments on winter solstice would be seen as having a distinct cosmology to another regional group with summer solstice alignments (Hoskin 2001). This is in spite of many well attested cases of complex monuments exhibiting a grammar of combined alignments arranged in parallel, transverse and reverse pairings (Ruggles 1999; North 1996; Hively and Horn 2006). And even though one of the most impressive field work reports and statistical analyses ever conducted in archaeoastronomy has found a preponderance of lunar alignments (southern standstills in particular) in five regional groups of prehistoric monuments in the British Isles

(Ruggles 1999), both the author and the discipline are reticent to submit lunar data sets to intense investigation. This is in keeping with a deep assumption within archaeology that such is the complexity of the moon's horizon properties compared to those of the sun, that farming cultures just emerging out of foraging lack the sophistication to design monuments with lunar alignments. This view is contradicted by that of anthropology, which sees hunter-gatherers as fully human, as 'sophisticated' as agriculturalists, and who use lunar cycles to time their ritual life (Sims 2006). However, in the interests of carving out a professional discipline acceptable to academe, present archaeoastronomical practice tends to focus on statistical methods to test groups of monuments reduced to single axial alignments on the sun.

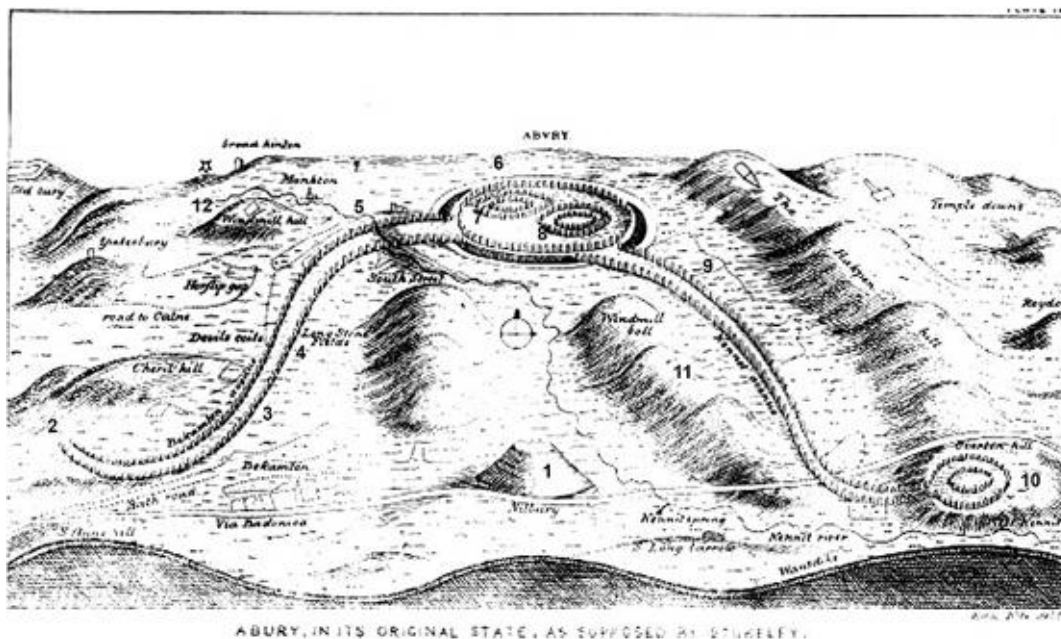
Science should not be limited to the socio-political pressures of institutional acceptance. We should let the data speak for itself. We can raise our sights and include in our aims testing alternative models other than null that reject or minimise the possibility for 'astronomical' alignments. By selecting those models marshalled by archaeology and anthropology to interpret monuments, and testing them alongside the evidence of archaeoastronomy, we can suggest how robust datasets drawn from these three (or more) disciplines have a limited number of combinations, which in turn allows only a very few reconstructions of an 'emergent' system of meaning (Sims 2009). This paper demonstrates this argument through examining claims made by some archaeologists for the approach made by the West Kennet Avenue into the Avebury Henge, in Wiltshire, England.

## 2. Archaeology and the West Kennet Avenue approach to the Avebury henge and circle

The West Kennet Avenue is one part of the unique Avebury monument complex built during the third millennium BCE that connects the Sanctuary wood and stone circle with the Avebury henge and circle (Fig. 1). The Avenue was composed of about 100 pairs of parallel stone pillars, of which those remaining after centuries of abuse have an average height of 2.26 metres arranged in quadrangular settings 14.7 by 23.2 metres apart (Sims, Field Notes). The excavations and restorations carried out by Keiller and Piggot showed that the Avenue was built in series of straight sections, not in a smooth serpentine shape as suggested by the eighteenth century antiquarian Stukeley in Fig. 1 (Keiller and Piggot 1936). Where stones were missing, they placed concrete markers above the excavated

stones holes where they had once stood, so giving a near complete record of the northern section of the Avenue. Stones and markers are identified by numbered pairs 1-37 going south on leaving the Avebury henge, and by row 'a' on the east and 'b' on the west.

Fig. 1 Main Features of the Avebury monument complex according to Stukeley (Mortimer 2003, pp. 50-51).



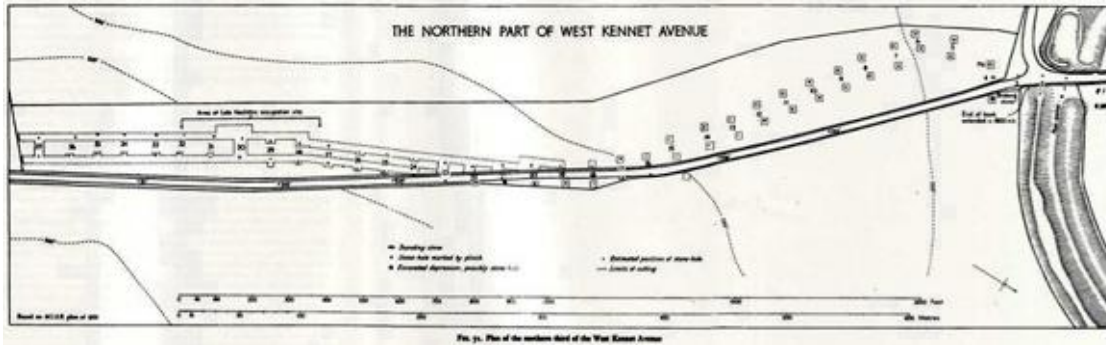
Key

1 Silbury Hill; 2 Start of Beckhampton Avenue at Fox Covert; 3 Beckhampton Avenue; 4 Longstones Cove; 5 River Winterbourne; 6 Avebury Circle and Henge; 7 Northern inner circle; 8 Southern inner circle; 9 West Kennet Avenue; 10 Sanctuary; 11 Waden Hill; 12 Windmill Hill.

Paradoxically Keiller's plan survey of this section of the West Kennet Avenue shows it heading away from the southern entrance of the henge from pair 13 to 6, while from pairs 6 to 1 it seems to repair the 'error' by an awkward zig-zag route to then connect with the southern entrance (Fig. 2). Recent archaeological commentary on the Avenue has suggested two interpretations for this convoluted approach route.

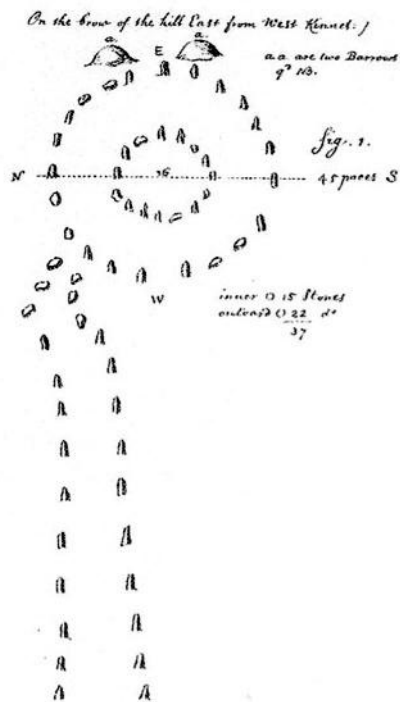
Burl claimed that this was a mistake of the prehistoric builders in starting the Avenue at both ends but failing to anticipate an accurate direction for each section to join up (Burl 2002). Gillings & Pollard argue that Keiller's excavation plan is a mistake and re-excavation will establish a more direct route for this section of the Avenue (Gillings and Pollard 2004, p. 78). Burl's suggestion of the builder's poor route-making abilities might be taken seriously if the join in two sections took place in the middle of the 2.4 kilometre Avenue, but it is unconvincing when the 'poor join' at stone 4b is just 30 metres from the southern entrance. If it were a mistake, then it cannot explain why elsewhere in the

Fig. 2 Keiller & Piggots' plan of the excavated northern section of the West Kennet Avenue (Smith 1965, Fig 71).



Avebury monument complex are displayed highly accurate pre-planned features (Sims 2009). Lastly, an earlier antiquarian of the seventeenth century, John Aubrey, recorded how the other end of the Avenue connected to the western entrance of the Sanctuary in exactly the same dog-leg design, the same flat sides of the stones in line with the Avenue

Fig. 3 Aubrey's plan of the West Kennet Avenue southern approach to the Sanctuary (Ucko: 1991)



Note: a) The Avenue approach, just as at the northern end, heads away from the Sanctuary entrance b) The Avenue approach to the Sanctuary is uphill, whereas at the northern approach to the Henge it is downhill c) Each row of the Avenue, before the final kink, is a tangent to each of the nested stone circles of the Sanctuary, whereas at the northern approach to the Henge the Avenue is a tangent to the outer bank d) the flats of the stones were in line with the direction of the row.

route, and the same device of using a change of slope in the landscape in the final approach to the Sanctuary as in the northern approach (Fig. 3). However, Burl's view of the builders is consistent with the archaeological assumption of farming revolution theory that they were 'howling barbarians' (Atkinson 2003) just emerging from the primitivism of foraging. Pollard's suggestion that Keiller's excavation record is inaccurate is also suspect. It is true Keiller made some mistakes in his record of the West Kennet Avenue. He placed a concrete marker at position 30b, where no stone had ever been placed, and he failed to place a marker at position 4a where a stone had once stood (Smith 1965; Sims forthcoming), although these are errors Pollard would find hard to accommodate in his theory of avenues. Pollard's view stems from a model which sees Avenues as lithicised commemorations of pioneer ancestral pathways into a region, and considers it improbable that those Mesolithic foragers would have taken such an indirect route as Keiller identified. It also suits the sensibilities of the modern tourist board for the monument (the National Trust) who have mowed a short cut along this section of the Avenue which ignores stone pair 6 in a streamlining of its actual route (Fig. 4). But this is a theoretical, not empirical, case for challenging the zig-zag Avenue route near its connection with the southern henge entrance which would fall if we can find another theory which can explain the archaeological evidence of Keiller's site excavation.

Fig. 4 The final approach of West Kennet Avenue to the Avebury henge.



Note: Author's photo of the final approach section of the West Kennet Avenue to the Avebury henge, June 2010. The photo is taken from position 6b looking towards stone 4b. The flat side of stone 4b points into the southern henge entrance but, unlike stones between pairs 13-37, is orthogonal rather than in line to the direction between pairs 4-6. The Avebury Henge bank can be seen behind stone 4b. The eastern terminus of the bank is located at the base of the large tree. Notice that the mowed tourist footpath ignores the area between stone pair 6 in a modern shortcut.

### 3. Anthropology and the shift from brideservice to brideprice.

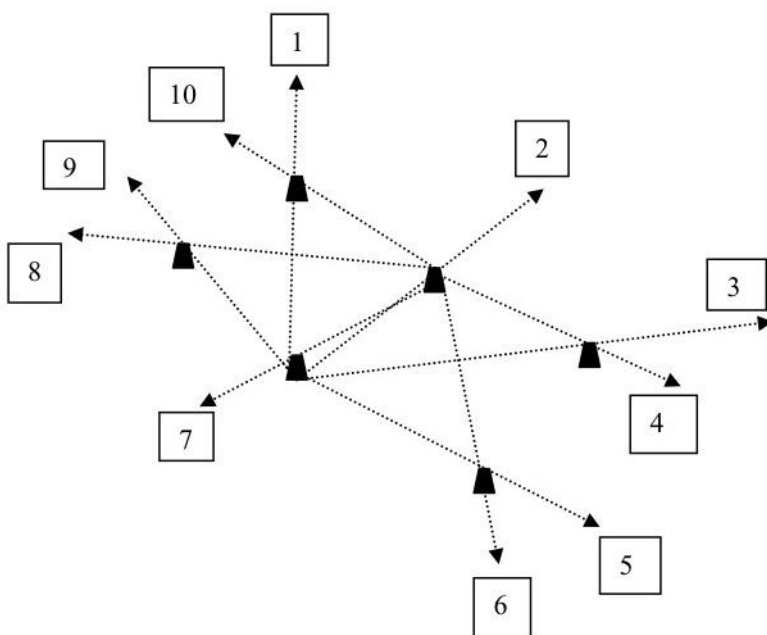
We have two models from archaeology, the primitivist and memory models, which deny the evidence of one of the most accomplished practitioners of the defining method of archaeology – site excavation. Anthropology would be concerned that in the transition from Mesolithic foragers to Neolithic ‘farmers’, key politico-economic changes were being ignored by this archaeological view, and these may account for this paradoxical property of the Avenue. The switch from hunting and gathering to cattle pastoralism involves hunting brideservice being subverted by cattle brideprice. In pastoralism a man gains a permanent wife with a payment of cattle which would substitute for a lifetime’s hunting services to her kin (Aberle 1961; Douglas 1969; Holden & Mace 2003; Jamieson 2010; Murdock 1949; Richards 1950; Schneider 1961). Women are now ‘wedlocked’ and men are divided by differential cattle ownership. Or as Aberle put it: ‘the cow is the enemy of matriliney’ (Aberle 1961, p. 680). Thus, whereas farming revolution theory sees a rise in ‘civilisation’ from foraging to agriculture, anthropology sees a socio-political reversal in marital and economic relations combined with an advance in technology. Archaeoastronomy provides a method to test hypotheses generated by these different models. Archaeological models emphasise single axial alignments on the sun or none at all. Anthropological models predict lunar symbolism for hunting cultures that would be gradually undermined by solar symbolism with the beginnings of pastoralism (Sims 2006). It should be possible to observe traces of either paradigm in the paradox of an Avenue that until the last moment heads away from its destination.

### 4. Unexplained design features of the West Kennet Avenue

We can begin by respecting the details of this section of the Avenue by looking for aspects of its design which are unexplained by the current archaeological models. From pair 13 to 7 the Avenue is straight and takes us downhill towards the henge in a line that is a tangent to the outer south western bank of the henge which continues on to the summit of Windmill Hill (Fig. 1). Just at the point where the modern tourist footpath veers away from the Avenue in a modern shortcut, stone pair 6b’s position continues veering away from the southern entrance by occupying the lowest point in this section, only to require a sharp turn to the east uphill to pair 4, followed by another sharp turn this time to the north to pair 1 and so into the henge (Fig. 2). A route that loses height to then require immediately

regaining it is not what we would expect of Mesolithic foragers, just as tourists today seem to agree by taking the modern shortcut! However, such a strategy is perfect for lowering the eye of the observer processing along the Avenue. Passing stone 4b, which is the only remaining stone from markers 1-12 along this section of the Avenue, this flat quadrangular slab of a stone (Fig 4) is aligned in line with a route consistent with the zig-zag alignments confirmed by Keiller's excavation (Fig. 2). In all these respects - the Avenue as tangent to the outer henge bank rather than entrance, a route that crosses contours to change the altitude of the observer's eye, and the flat sides of stone confirming these layouts – Aubrey's record of the southern terminus of the Avenue replicates all of these properties that we find in Keiller's record of the northern terminus. Unless Pollard has evidence that all the concrete markers from pair 12 to 5 are incorrectly placed then the conclusion must be that Keiller's record is correct and needs to be interpreted with some model that transcends the limits of the primitivist and memory models. An alternative model is suggested by the properties we have just noted. A circuitous route which manipulates the eye height of the observer is simultaneously altering the altitude of the surrounding horizons. Having set aside two archaeological models we can now test whether horizon events coincide with the arrangement of stones along this restored section of the Avenue.

Fig. 5 The ten possible orientations from any pair of stones to adjacent pairs.

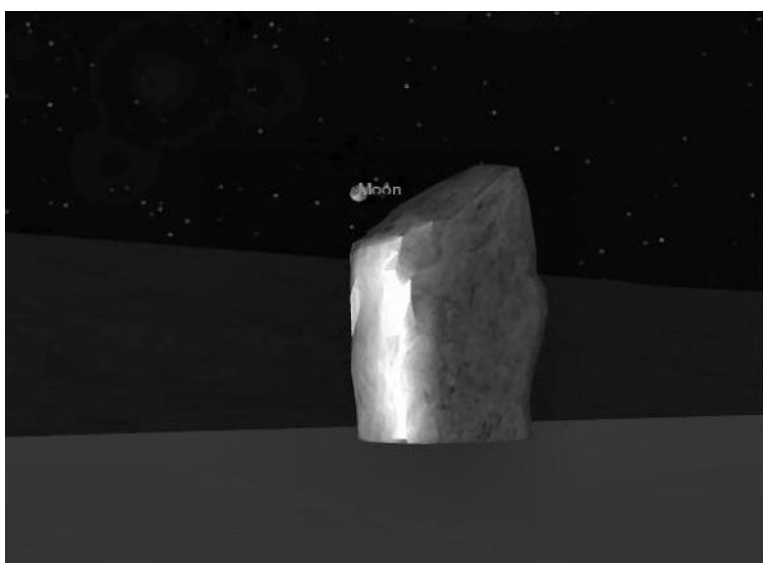


## 5. Method



We have no knowledge of how the builders of the Avenue might have aligned paired and adjacent stones along the Avenue. For those archaeoastronomers wedded to a 'Thomist' expectation for highly accurate alignments (Thom & Thom 1976; see Heggie 1981 and Ruggles 1999 for critique) this poses a problem. The average mid-width of the surviving stones is 1.7 metres and pairs are placed on average 14.7 metres apart and diagonals 27.5 metres apart. This allows maximum average ranges across alternative sighting alignments of  $11^\circ$  for paired stones and  $5.5^\circ$  for diagonal stones – huge ranges for those accustomed to plotting alignments accurate to fractions of a degree. However, if you accept an 'ethnographic' (Ruggles 1999) or 'religionist' (North 1996) motivation for ancient sky lore, then this large range of sightings over the tops of stones when viewed from adjacent stones is an advantage for constructing the artifice of observing cosmic bodies entering or leaving the stones at settings and risings. Seen this way, the stones can be constructed as 'portals' for the passage of solstice suns and standstill moons between the heavens and the underworld. In keeping with this ethnographic logic a range of  $5^\circ$  to discriminate any horizon event of the sun or moon along the top of any stone when viewed from an adjacent stone is the maximum accuracy required to capture this effect (Sims 2010). While farming revolution theory would find it difficult to accept the high fidelity alignments predicted by the Thom model of archaeoastronomy, there is no reason why it cannot accept this 'religionist' understanding of prehistoric sky lore. We can classify all of

Fig. 6 Computer simulation of virtual model of West Kennet Avenue with northern minor standstill moon setting into stone 35b from left of stone 36a. Source: MacDonald 2009.



N.B. Notice that the half-degree diameter of the moon could, with slight adjustments in the viewing position of the observer, accommodate a large range for observing this effect across the breadth of the stone from a distance of 27.5 metres.

the ten logically possible adjacent alignments for any pair of stones as shown in Fig 5. Azimuth field sightings were made in both directions with a compass accurate to half a degree, and horizon altitudes measured with a clinometer. Field work was repeated three times with different observers to check for recording errors. In addition a virtual model of the Avenue using Keiller's site survey plan was built independently of this fieldwork by MacDonald, integrated into an accurate virtual landscape using Ordnance Survey topographic data, all combined with an accurate and realistic moving skyscape that could be set for any date between 4k BCE to the present (MacDonald 2007). An example of one of the many alignments captured from this computer simulation is shown in Fig 6, and the field data results are shown in Table 1.

## 6. Findings

While this paper concentrates on the Avenue properties between pairs 7 and 1, the 167 lunar-solar-cardinal alignments shown in Table 1 between pairs 37-1 are far more than can be accounted for by chance alone (Sims 2010). It is also clear that there is a good 'archaeoastronomical' reason why the approach route of the Avenue does not head straight for the southern entrance, but veers to the north-west at a tangent to the outer henge bank – it's line is dedicated to align on the summer solstice sunsets between pairs 12 and 7 with a switch to the northern minor standstill moonsets between 7 and 6 (orientations 9 & 10). The subsequent zig-zags between pairs 6 and 1, rather than being 'awkward' or a mistake are also made to maximise further cardinal and lunar-solar alignments. Interestingly, at the junction of pairs 7 and 6, the main point at which the Avenue changes direction towards the southern entrance, there are combined cross cardinal alignments to the west and the north. These cross-cardinal alignments match the builders' gender inflected burial practices in which gender is demarcated by cardinal alignment, with an 80% emphasis on male burials all orientated to the north (Tuckwell 1975). It is also interesting that while the main direction towards the southern entrance by way of the Avenue concentrates on summer solstice sunsets up until pair 7, from then on all remaining adjacent pairs emphasise lunar alignments on northern minor and major lunar standstill moonsets into the henge. This lunar-solar combination of summer solstice sunsets and northern standstill moonsets, predictably and invariably generates a synchronisation of dark moon at summer solstice – exactly what would be predicted by a lunar governed ritual system based upon dark moon seclusion rituals transposed onto a

Table 1 Alignments of West Kennet Avenue stone pairs 1-37 with adjacent and opposite stones

Comb: Pair	1	2	3	4	5	6	7	8	9	10
1								NMajS		
2			SMinR					NMinS		
3				SMajR		South	SMinS			NMajS
4		NMinR	South				WEST			NMajS
5			SMajR			South		North		
6	North						WSS	NMajS		
7		SSR		WSR	WSR		SMajS	West	NMinS	NMinS
8			East	SMinR	SMinR				SSS	SSS
9			East	SMinR	SMinR		SMajS	West	NMinS	SSS
10				WSR	SMinR		WSS		SSS	SSS
11			East		WSR		WSS		SSS	SSS
12			East	SMinR	SMinR		SMajS	West	SSS	SSS
13				WSR	SMajR		SMajS	West	NMinS	NMinS
14				WSR	WSR		SMajS	West	SSS	NMinS
15		NMajR	East				WSS	West	NMinS	NMinS
16		NMajR				South	WSS	West		
17	North	NMinR	SMinR	SMajR	SMajR	South			SSS	
18	North	NMinR	SMinR			South			NMajS	NMajS
19	North	SSR						NMinS		
20	North	SSR	SMinR			South	SMinS	NMinS	NMajS	
21	North	NMinR	WSR	SMajR		South		NMinS	NMajS	
22	North	NMinR	SMinR			South		SSS	NMajS	
23	North	NMinR	SMinR			South		SSS		
24	North	NMinR	SMinR					NMajS		
25		NMinR	SMinR					SSS		
26		NMinR	SMinR					SSS		
27		NMinR	SMinR					NMajS		
28	North	NMinR	SMinR					NMajS		
29	North	NMinR	WSR					SSS		
30	North	NMinR		SMinR				NMinS		
31			WSR					SSS		
32		NMinR						NMajS		
33	North	NMinR	SMinR					NMinS		
34	North	NMinR	SMinR					NMinS		
35					SMajR			NMinS		
36	North	NMinR	SMajR	SMajR				SSS		
37	North	NMinR	SMinR	SMajR	SMajR			SSS		

Note

For any pair of stones with adjacent pairs on either side, the ten possible combinations of pairings from the central pair to all six stones are shown in Fig. 2. These combinations are numbered clockwise 1-10 as azimuths from North starting at the northern diagonal and are the column headings in this table. The row headings identify the number of the stone pair positions 1-37. The azimuth bearings for zero horizon altitude at this latitude of 51° 25' for lunar standstills, the sun's solstices and cardinal alignments (not to be confused with equinoxes) are: North 0°/360°; Northern Major standstill moonrise (NMajR) 40.5°; Summer Solstice sunrise (SSR) 48°; Northern Minor standstill moonrise (NMinR) 59°; East 90°; Southern Minor standstill moonrise (SMinR) 121°; Winter Solstice sunrise (WSR) 129°; Southern Major standstill moonrise (SMajR) 141.5°; South 180°; Southern Major standstill moonset (SMajS) 218.5°; Winter Solstice sunset (WSS) 231°; Southern Minor standstill moonset (SMinS) 239°; West 270°; Northern Minor standstill moonset (NMinS) 301°; Summer Solstice sunset (SSS) 312°; Northern Major Standstill moonset (NMajS) 320.5°.

solar timescale (Sims 2007). For those processing north along and outside the parallel rows of Avenue stones, they would have seen a changing vista of stone combinations of first summer solstice setting suns setting into their tops followed by, twice every nineteen

years, the setting minor and major standstill northern moonsets. Fig 6 shows a computer simulation of this effect. At that part of the Avenue when its zig-zag route disallowed a lunar-solar alignment across stones, they contrived to manipulate their position to construct an alignment on north – a direction that they also used to align male corpses. Solstice suns and standstill moons setting into stone tops and the northern centre of the heavens would be seen when travelling alongside the Avenue when moving towards the Avebury stone circle, and risings when moving towards the wood and stone monument of the Sanctuary.

## 7. Conclusion

The ‘astronomical’ properties we have found for the West Kennet Avenue approach to the Avebury henge and circle are exactly what would be predicted by an anthropological model in which a male-dominated cattle herder society is appropriating and subverting a lunar-governed ritual cycle onto a lunar-solar cosmology. This model can therefore provide an interpretation for the excavation findings of Keiller and Piggot which modern archaeology cannot. Where once foragers had naturalistically entrained their rituals with lunar cycles, with the technical advance of domesticated cattle as moveable property, gender and economic relations are now characterised by compulsion and inequality. Now ritual specialists had to construct ‘the pathways to the gods’ to keep a connection with their ancestral beliefs while simultaneously undermining them. This model both explains the findings of archaeoastronomy and at the same time integrates those findings that remain from archaeology and anthropology. In this multidisciplinary integration of data sets, it is archaeoastronomy that is the keystone discipline in the intellectual arch. A unique Avenue aligned on sun, moon and cardinals whose route goes the ‘wrong’ way for archaeology may point the ‘right’ way for the future of archaeoastronomy.

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## OUT OF AFRICA: THE SOLARIZATION OF THE MOON

Lionel Sims

### Abstract

The findings of archaeoastronomy do not fit the traditional archaeology of prehistory. A new and more recent archaeological model offers possible convergence between the two disciplines if elaborated with the anthropology of the shift from hunting to pastoralism. This paper tests the traditional model and this new elaborated model with the archaeological evidence of the Avebury monument complex in Wiltshire, England. Whereas the excavator of Avebury, a proponent of the traditional model, could only find paradox and anomalies in his data, this paper suggests that all are annulled when using the second model of cattle owning solarising pastoralists appropriating and undermining the hunters' lunar-scheduled rituals which ultimately derive from our African ancestors.

**Keywords** *Lunar-solar, solarisation, bride-price, pastoralism, reversal, gender-ambiguity, sacrifice, death, resurrection.*

The discovery by archaeoastronomy of many lunar-solar alignments in Neolithic and Early Bronze Age European monuments (North 1996, Ruggles 1999) is at odds with the expectations of the traditional archaeological model of this period. According to this model it is thought that a rich material culture from sedentary intensive agriculture is necessary to provide the material referents to stabilise memory and symbolic meaning (Renfrew 2001; Rowley-Conwy 2011). A hunting life style is viewed as having little material culture, so these 'primitive' peoples are yet to become fully human. Lunar-solar alignments at Neolithic monument would reflect a level of sophistication that this traditional model would not allow. Nevertheless it is the evidence of archaeoastronomy that has stood the test of time, and this archaeological model of the agricultural revolution has been eclipsed by a new model of the Neolithic. This suggests that culture and social order began with already fully human Palaeolithic hunter gatherers in low latitude Africa, and that intensive sedentary agriculture was not adopted in NW Europe until the middle Bronze Age. Instead hunters of the late Mesolithic selectively adopted cattle pastoralism while continuing to hunt and forage and only occasionally planting, all within a semi-mobile lifestyle. And although there was significant regional variation in each particular mix of these strategies, there was a remarkable uniformity in monument building (Thomas 1999, Tilley 1994, Whittle 1996). More widely, where epi-Palaeolithic changes in climate were more rapid and challenging to a hunting strategy, as in the Near and Middle East, there was an associated and more rapid adaptation. This provides the context for the monuments at Gobekli Tepe,



built by hunters eleven thousand years ago in Anatolia long before the Neolithic 'revolution'. The earliest of these monuments are the most impressive with later examples declining in scale and sophistication, indicating that late Palaeolithic hunters rather than early Neolithic 'farmers' were more sophisticated than the traditional model allows (Mann 2011).

This second model in archaeology is much closer to the field evidence of archaeoastronomy. The first model assumes that hunters of the Palaeolithic and Mesolithic were unable to stabilise institutions or have the resources to build monuments, while in the second model the Neolithic cannot be understood except as a reaction and accommodation to the hunting rituals and cosmology that preceded it. It sees the monument builders as continuing their forager ancestor rituals, although now modifying them to adapt to a loss of their former egalitarianism and social solidarity. In particular, the shift from a hunter's bride-service to a cattle owner's bride-price led to a reversal in socio-political marital relations, with a significant deterioration in women's status. Women became the chattels of men's cattle exchanges. Gender inflected concepts of reversal and appropriation are therefore implicit within this model of the pastoralist adaptation of our forager ancestors. While traditional archaeology also sees wealthy patriarchal males leading megalith building, for this model it is foundational of culture *not* a politico-sexual reversal.

For archaeoastronomy to test and contribute to these models we need to specify them as precisely as possible. The first traditional model would see astronomy as beginning from humble origins with special emphasis on calendrical alignments in the service of a domesticating economy. Simple alignments on solstice sunrises would serve such an agenda. The second model would see 'astronomy' as sky lore in the service of consolidating rituals adapting to a breakdown in forager clan solidarity. However, the legacy of past hostility to archaeoastronomy by archaeology has encouraged little elaboration of what 'astronomy' this might involve. There is the further problem that academic compartmentalisation separates specialists in Neolithic archaeology from those who study the Mesolithic and Palaeolithic. We have a number of pointers to the shape and content of the hunter cosmology that preceded the monument builders. Destro-Bisol et al. (2004) show how the MitDNA compared to the Y-chromosome evidence supports the interpretation that our ancestors were matrilineal and matrilocal. Watts (1999) has shown that African red ochre mining and use was general and sustained by 120k years ago and being used for symbolic purposes. And contra D'Errico (1998), Marshak's findings for lunar

'calendar' sticks, with an emphasis on dark moon notation, suggests an ancient engagement with the moon (Marshak 1972). All of these components are consistent with and predicted by sex strike theory, which sees the origins of culture in women's dark moon menstrual blood seclusion rituals which signalled for eligible sexual partners to conduct a collective hunt for meat provisioning at full moon (Knight et al. 1995).

Sex strike theory makes very precise and testable predictions for 'astronomy' and gender amongst Palaeolithic hunters. The seclusion rituals of matrilineal coalitions of women, so denying sexual access to approaching males, would have made themselves ritually inviolable and therefore powerful. Without assuming language the model suggests that to achieve this they would have reversed the signals of an animal mate recognition system. Animals about to mate must ensure that the other is the same species, that they have chosen the right sex, and that it is the right time. Only humans can masquerade the reverse and signal to out-group males that we are the wrong species, the wrong sex and it is the wrong time. Men as brothers to their classificatory sisters would have supported them in their seclusion ritual against their husbands. Both men and women as siblings separate themselves off from their other aspects as husbands and wives. As a secluded anti-heterosexual coalition this masquerade gender means power, whereas when after full moon the seclusion comes to an end the prohibitions are relaxed and biological gender is allowed to reappear. The gender of power alternates with weak gender according to lunar phases. This model sees the sacred symbolic domain during the waxing moon as populated by therianthropic, gender ambiguous and red-ochred beings. The Palaeolithic record is replete with examples of therianthropes, gender ambiguous figurines and red ochre. However, if forager women lost ritual power in the Neolithic to pastoralist men, then we would predict that their ancient cosmology would have been appropriated and reversed by the new male monopolisation of ritual power. Now, instead of inventing rituals *de novo*, as the traditional archaeological model predicts happened in the Neolithic, we would expect that males will be subverting by appropriation rituals invented by African women millennia before. To be legitimately powerful, men's displacement of women would now at dark moon rituals require them to masquerade as animal, female or gender ambiguous and bleeding. We would expect that this process would involve not just mimesis but also symbolic substitutions and recalibrations more in keeping with the dynamic of a male-led cattle owning society. In particular we would expect some solarising dynamic to appropriate and undermine the previous sanctity of lunar phase-locked rituals.

By combining the second archaeological model with sex strike theory we have a new integrated model which expects the Neolithic to be characterised as a process of socio-political reversal undermining women's lunar-scheduled gender of power seclusion rituals. The first traditional archaeology model says very little about gender other than an androgynous elision which conceals an assumption of male power and leadership and female domestication (Gero 1991). Rather than any complex engagement with lunar 'astronomy', this first model would expect to see rudimentary solar alignments in the service of the first calendar constructions. While the first model sees the monument builder's journey emanating from the Near East to the rest of Europe and Asia in a shallow time scale, the second model traces our ancestors from leaving Africa bringing with them a ready-made lunar scheduled culture in a deep time scale.

We can list a series of alternative hypotheses generated by the Neolithic Revolution traditional archaeology model (1) to the Palaeolithic Continuity herder reversal model (2). Model 1 expects ritually powerful males to be heterosexual, whereas model 2 would expect them to be gender ambiguous therianthropes. Whilst model 1 expects hunter savagery blood sacrifice to be replaced by civilising laws, model 2 predicts a male monopolisation of blood rituals which will include male sacrifice. While model 1 expects rituals of heterosexual fertility, model 2 expects anti-marital waxing moon rituals which ensure the sanctity of blood ties over marital ties. Astronomy in model 1 is in the service of agriculture and building institutional order, whereas in model 2 the emphasis will be on ritual repair to the damage in the cosmic fabric by maintaining cosmic cycles. While model 1 expects solar alignments on a visible sun, model 2 expects a focus on dark moon rituals displaced onto solar cycles.

The assumptions of model 1 are shared by the main excavator, Alexander Keiller, in his report of the Avebury monuments in Wiltshire, England. He claims that the stones of the Avebury Circle and the West Kennet Avenue are shaped to signify gender. Pillar shaped stones (A) are male and lozenge shaped stones (B) are female. 'If the A and B stones in the Circles and Avenue do indeed represent male and female symbols, the implication must be that the monuments were dedicated to a fertility cult' (Smith 1965, 251). The same claim has been made more recently for the bluestones at Stonehenge (Darvill 2006, 127). Along the parallel two rows of stones of the West Kennet Avenue at Avebury, labelled row a to the left and row b to the right on leaving the henge, Smith claims that pillar and lozenge stones face each other across the Avenue and alternate along its length. The stones or their markers are numbered from pair 1 at the south entrance to the

Avebury henge and circle, and recovered and remounted stones extend up to stone pair 37. Beyond this the Avenue had once extended up to a total of around 100 stone pairs to the Sanctuary stone and wood circle some 2 kilometres to the south east.

What the excavator called 'burials' are located on the north east side of stones 18b, 22b, 25b and 29a. Three adult males and two adolescent boys are placed in shallow holes between 20-60 cms deep. They are flexed, and one male has ante-mortem cuts on two femurs and one adolescent had a humerus bone forced through the jaw into the base of the skull. While stone 22b is missing, the other three stones are all 'female' lozenge stones. Therefore, according to the excavator's own criteria of gender, males sacrificed in blood rituals are bracketed with female stones in a posture of re-birth.

However, the claimed shape of the stones does not bear scrutiny. One stone, 35a, is both pillar and lozenge according to whether it is viewed from across or from along the Avenue. Three stones, 4b, 33a and 33b, are all massive quadrangular slabs, which could have been presented as lozenges if they had been set on one of their corners instead of upon one of their sides. The only two stones which are stereotypically pillar and lozenge are 13a and 13b, and it is these two stones which are usually pictured in the service of this claim. Pillar 13a is 2.4 times higher than it is broad, and lozenge 13b's middle is 2.7 times broader than its base. If we conduct a thought experiment, to turn these two stones into their opposite anti-pillar and anti-lozenge we would have to set both ratios to zero. A pillar that is as broad as it is tall is quadrangular, and a lozenge's middle that is the same dimension as its base and top is also quadrangular. Therefore the opposite of pillars and lozenges merge to identity at their limit. All the stones between pair 13 and pair 33 present some intermediate shape between lozenge/pillar to quadrangular slab/or ambiguous pillar/lozenge. This includes the three stones already mentioned marking the places of male sacrifice, since while showing a slight diamond lozenge shape, they ambiguously combine with it a broad pillar-like mass. Therefore, if pillar and lozenge are heterosexual markers of male and female, since stones along the West Kennet Avenue morph into quadrangular slabs or ambiguous pillar/lozenges, then these other stones must be icons of androgyny. While stone pair 13 seems to fit Keiller's heterosexual criteria rather than this being an Avenue of heterosexual fertility most of the surviving stones have shapes consistent with gender ambiguity.

To be true to model 1, if the Avebury monuments were a celebration of fertility, then we would expect ritual elaboration around those stones most representative of heterosexual fertility, namely stone pair 13 along the Avenue. For this model it is a paradox that there

are no deposits whatsoever around these stones. Instead there is a massive concentration of exotic and patterned deposits between stone pairs 28 and 32 all focussed around position 30b. In this area worked flint deposits were found in a zig-zag pattern across the Avenue on the top of the chalk and carefully selected and patterned deposits of other materials in a series of ten naturally occurring holes and two artificial pits along this length of the Avenue. In keeping with the assumptions of model 1, and using the deposited materials in the holes as proxies for evidence of occupation, Keiller called this area along the Avenue, the 'occupation area'. He also placed a unique concrete marker at position 30b, even though there was no evidence from excavation that there had ever been a stone in that position in the Avenue. '...[T]he holes...cannot be interpreted as adjuncts of normal habitation. It is difficult to evade the conclusion that this site has a direct connection with the Avenue and it is a coincidence worthy of remark that no evidence could be found for the existence of a stone opposite stone 30a...[T]he coincidence is a curious one' (Smith 1965, 212). If the holes cannot be evidence of occupation, if the builders did not want a stone at 30b, and if this was all a piece with the Avenue, then this 'curious coincidence' calls for further thought. I have shown in an earlier paper that the Avenues, Silbury Hill and Circles of the Avebury monument complex are designed to simulate a journey through the underworld focussed on a dark moon ritual at the Avebury henge (Sims 2009). When leaving the Avebury Circle's dark moon henge, by the time we arrive at position 30b we are 29.5 stone pair positions away from a dark moon marker, which brings us one average synodic month to another dark moon position. An absent stone is consistent with signifying dark moon, while stones pair 13 being the tallest along the Avenue is also consistent as a full moon marker. These interpretations are consistent with model 2 and cancel the anomalies which make this a 'curious coincidence'.

While sex strike theory predicts that sacred blood flows at dark moon but none of the sacrificed males were actually located at position 30b. Is there any other evidence that blood would have flowed here? The ten natural holes and two artificial pits within the 'occupation area' pivot around position 30b. Eight holes are in a line parallel with the Avenue on its west 'b' side from stone position 32b to just past 30b, and two holes and two pits switch to the other side of the Avenue in another parallel line from positions 29a to 28a. On the b side of the Avenue moving north towards the henge from 32b are first the broken butt end of a polished axe (type VII), followed by a marked concentration of unused sharp cutting flint tools ending in this line with the cutting edge of a polished axe (type VII) at position 30b. Now switching to the other side of the Avenue at stone 29a we have the

'grave' of an adult man, and in the two pits and two holes that follow we have bone fragments of ox, pig, red and roe deer (Smith 1965, 206-16). Therefore moving north outside and along the Avenue towards the Avebury henge we have instruments of death and dismemberment around stone positions 32b-30b and, switching to the other side of the avenue, a sacrificed man and animals from 29a to 28a. Twelve holes and pits containing the instruments and evidence of blood rituals surround and pivot the thirteenth 'empty' position 30b. This archaeological evidence, which is completely at variance to the predictions of the main archaeological model, confirms the prediction that position 30b as a dark moon marker is associated with the point at which blood will be spilt, and that sacred male blood is in communion with the animal domain.

We have found anti-heterosexual stones organised according to a lunar sequence, the male monopolisation of blood sacrifice, and pivoting around the absent stone at position 30b the communion of a sacrificed male with butchered animal remains. Therianthropic anti-heterosexual male monopolised dark moon blood rituals cannot be explained by model 1 but are predicted by model 2. Therefore the evidence of archaeology undermines the traditional archaeological model and shows that lunar governed gender of power rather than heterosexual fertility motivated the monument builders.

To test the model 2 hypothesis that these dark moon rituals were solarised we need to look in more detail at previously unnoticed properties of the Avenue's design and location. Gillings et al. note that the space within the Avenue is littered with a natural spread of sarsen stones close to the surface which would have been hazardous for any procession, and cites this as possible evidence for the 'construction' perspective in which no actual procession ever took place within them (Gillings et al. 2009, 141-2). Yet elsewhere Gillings et al. mention that the chalk that runs along and just outside the Avenue, unlike that within the Avenue, is compressed. If we combine both pieces of data this suggests that processions did in fact take place *outside and along* the Avenue stones, so providing a changing vista of many stone pillar combinations. Standing alongside any stone from outside at the 1.65m eye-height of a Neolithic man (North 1996, 58), reveals the previously unnoticed property of opposite, adjacent and diagonal stones' tops coinciding exactly with the background horizon (Figure 1). This raises the possibility that the tops of these stones merge with some horizon event.

Four further properties need to be noticed. Pollard has provided data which shows the flint deposition within the 'occupation area' is deposited in a zig-zag arrangement that alternates between north-south and west-east (Pollard 2005, Figure 10.3). John North has

also shown that the stones themselves alternate cardinally along the length of the Avenue, with northings predominating between stone pairs 4-6 and 16-37, and westings between 7-16 (North 1996, 252-62). And by field survey these sections of the Avenue are partitioned in two places by placing three stones in line and crossing the Avenue joining stones 6b-5a-4a and 15b-16b-17a (Smith 1965, Figure 71; Sims, Field Notes). These in-line stones coincide and combine a switch in diagonal alignments from north to west (see Figure 3 and below). Finally for over one kilometre the course of the Avenue along the undulating eastern flanks of Waden Hill is approximately parallel to the same 330° orientation as its ridge, so providing a regular, steep and close high horizon varying in altitude between 5-7°. About 1.25 kilometres to the east lay another high and level horizon which offers an altitude from the Avenue of between 1-2°.

We should notice a number of properties suggested by these design details. First, in the Neolithic cardinal alignments are 'astronomical' alignments. Second, partitioning the Avenue by cardinal crossovers around stone pairs 4-6 and 15-17 is consistent with lunar phases counting from either pairs 1 or 30, since these mark crescent and full moons respectively. This adds weight to our assumption that Avenue stones are being counted by lunar phase position and that 30b is a dark moon marker. Third the gearing of horizon heights either side of the Avenue with a separation of about 5° will pull in relative azimuths by about 10°. This gearing sets to zero the difference between solstice and standstill alignments in opposite directions at this latitude. Across opposite stones therefore solstice suns and standstill moons would have allowed the appearance of full moons entering into or emerging out of the tops of stones in line with the background horizon. We will see below that in spite of this felicitous choice of landscape location they only chose to use this facility *in this way* once – at positions 15 and 16.

In an earlier exploratory treatment, John North characterised the West Kennet Avenue as a series of ideal quadrangular boxes of four stones, each allowing minor standstill and north alignments in the southern section and major standstill and west alignments in the northern section of the Avenue (North 1996, 252-62). We will instead use the stone pair as the unit of analysis, since this allows for changes in spacing between pairs along the length of the Avenue. The ten logically possible paired stone combinations are shown in Figure 2. To follow this procedure immediately leads to a very different appreciation of the data. The horizon aperture of closely spaced large stones whose tops coincide with the background horizon is large. The observer's eye might be looking from the left or right side of the back-sight stone and to the right or left of the foresight stone, and still the effect

would be the illusion of a cosmic body emerging out of or descending into the top of the stone. The religionist hypothesis of model 2 predicts that this would be one 'astronomic' property the builders sought rather than the solar calendrical expectations of model 1. For this reason the large range afforded by closely placed stones for viewing such an effect would be *intentional and advantageous*, albeit contrary to requirements of fixing calendar time. Viewing across the different sides of paired stones gives an average deviation of  $11^\circ$ , and for diagonals  $5.5^\circ$ . Since the angle of separation between solstice and standstill alignments is about  $10^\circ$ , we will use a margin of  $5^\circ$  as a criterion across stones to discriminate between particular alignments. And as the property of stone tops coinciding with the background horizon can be found for any of the ten possible combinations of adjacent stones for any pair of stones, by field survey we can calculate the combined effects of azimuth and horizon altitude for all ten of their possible combinations. The same bearings can be taken across concrete markers, and all are shown in Figure 3.

The finding of 167 alignments along this section of the West Kennet Avenue cannot be dismissed as chance events, even taking into account the  $5^\circ$  alignment band to allow for closely spaced broad stones. For each of the ten straight sections the twelve lunar and solar and four cardinal alignments cover a total range of  $80^\circ$  and for the two end pairs a range of  $60^\circ$ . An average total range of  $76^\circ$  gives a just over one-fifth chance of hitting an alignment by chance. But since nearly 17 alignments have been found for each section out of 37 possible, this nearly one-in-two incidence of alignment is more than could be accounted for by chance alone.

We can now see that looking across and along the Avenue from the outside the alignments are not just lunar and cardinal as John North suggested but also solar. While there are 96 alignments on lunar standstills there are 36 on solstices. Third, walking north or south and looking forwards or sideways but not backwards along either side of the Avenue, each of the ten columns in Figure 3 show where the sun or moon can be seen to rise or set in each of the stone tops to the side, diagonally or in front of the viewer from an adjacent stone. The only place where sideways across two adjacent stones there is a reverse alignment in a single line on a solstice and standstill is in the full moon stone pairs 15 and 16. We already found by stone shape, numeration and lack of sanctified deposition that this was the area of the Avenue signifying the three or so days of full moon. We now find by alignment that this is the only area where the northern major standstill moonrise coincides with the winter solstice sunset (Cols 2 & 7 and Rows 15 & 16). This combination generates full moon in mid winter once every nineteen years.



For every other side, diagonal or forward view when walking alongside either row of stones there is always a majority of alignments on lunar standstills (major and minor) which are occasionally replaced with a solstice alignment. The identity pairing of standstill and solstice alignments across each possible pair of stones invariably predicts dark moon (Sims 2007). We have now confirmed that the Avenue is following a lunar partitioning displaced onto a solar timescale.

A completely unexpected finding is that lunar, solar and cardinal alignments within each section specified the handedness and direction of travel from outside the paired stones. Walking north from stone pair 37 the Avenue can be walked from either side viewing rising or settings (Cols 1 & 2 and Col 8), but only up to full moon markers between stone pairs 13-17. Once past this point the Avenue can only be walked northwards on the eastern side viewing settings alone (Cols 7-10 but not Cols 1 & 2). Contrarily walking south from stone pair 7 to the full moon markers the Avenue can be walked from either side viewing risings and settings (Cols 3-5 and 7), but once past the stone pairs 13-17 only walking on the west side of the Avenue viewing risings alone (Cols 2 & 3 but not Cols 6 & 7). Therefore when walking north from full moon positions 15-17 in the final approach to the dark moon ritual at the henge we see the paired settings of winter solstice sunsets and the southern major standstill moons, and when walking south from the same point towards the winter solstice sunrise Sanctuary circle we see the paired risings of winter solstice sunrises and the northern and southern minor and major standstill moonrises. Both arrangements further prescribe dark moon rituals at winter solstice sunset and sunrise twice every nineteen years at the circles either end of the Avenue.

A final observation can be made on the archaeoastronomy of the West Kennet Avenue. We began with the paradox of a missing stone at position 30b, explaining this as consistent with the interpretation of a dark moon position within a lunar scheduled Avenue. It can be seen in Figure 3 that either side of position 30b, at stone pairs 31 and 29, there are reverse diagonal alignments on winter solstice sunrise and summer solstice sunset (Cols 3 & 8 Rows 31 & 29). This arrangement occurs nowhere else along the Avenue. By the subtle adjustment of stone positions to negate the gearing of opposite horizons at these points of the Avenue, the builders have emphasised either side of position 30b that the year turns around the point at which blood is spilt. Rather than serving a calendrical function this monumental arrangement emphasises a ceremonial round alternating between solstice dark moon death and resurrection rituals.

## Conclusion

The traditional view of the Neolithic as a revolution that established society cannot accommodate the evidence of archaeoastronomy for a complex lunar-solar cosmology that exhibits properties of continuity and reversal with forager antecedents. A more recent archaeological model that sees prehistory going back to our Palaeolithic ancestors, suitably wedded to the anthropology of matrilineal coalitions of African hunters, suggests they used lunar scheduling for their culture establishing rituals. The new archaeological model shows that Neolithic monument builders in NW Europe were semi-mobile cattle herders, and their anthropology shows that in the transition from hunting bride-service to pastoral bride-price women become chattels in men's cattle exchanges. In this exercise we have been able to refute the traditional model of the Neolithic and confirm and elaborate the new model. Instead of ritually powerful heterosexual males celebrated at the Avebury monuments, we have found males sacrificed in blood rituals at the base of female stones alongside animal sacrifice during the waxing moon section of the West Kennet Avenue. As male monopoly the monument ritual displaces hunter egalitarianism. As male blood sacrifice it is a reversal and perverse modification of menstrual seclusion rituals. As gender ambiguous blood ritual it denies heterosexual marriage. In the intellectual arch of convergence with archaeology and anthropology, archaeoastronomy is a keystone discipline. With it we have revealed a lunar-partitioned Avenue indicating an ancestral logic appropriated and continued in monumental rather than human form. As lunar-solar paired stones it reveals rituals pivoted around dark moon death and resurrection in the service of turning the years. All of these findings reject model 1 but are predicted by model 2. Our forager ancestors journeyed out of Africa ready-equipped with a lunar phase locked cosmology, which was appropriated and reversed by solarising Neolithic pastoralists.

Figure 1 West Kennet Avenue looking north from 37b: the stone tops coincide with the background horizon.



Fig. 2 The ten possible orientations from any pair of stones to adjacent pairs

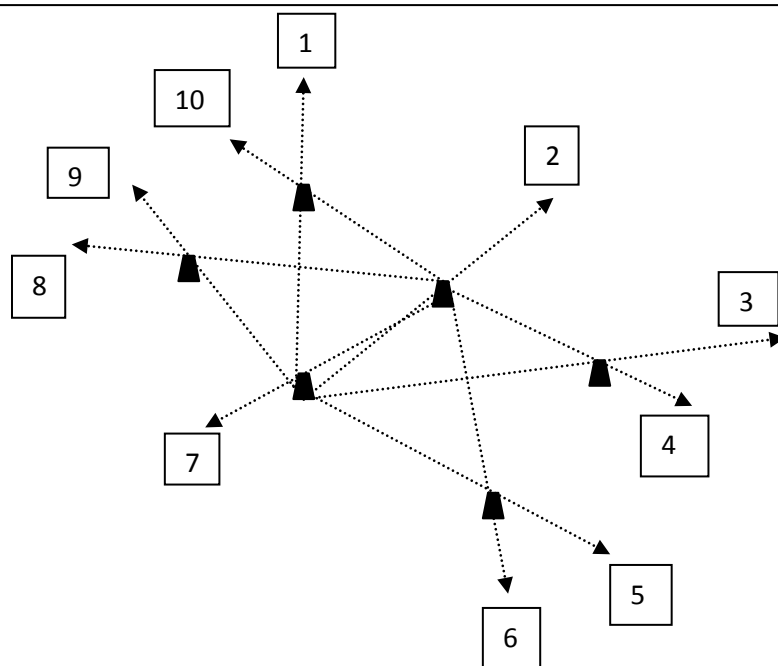


Figure 3 Alignments of West Kennet Avenue stone pairs 1-37 with adjacent and opposite stones.

Comb:	1	2	3	4	5	6	7	8	9	10
Pair										
1								NMajS		
2			SMinR					NMinS		
3				SMajR		South	SMinS			NMajS
4		NMinR	South				WEST			NMajS
5			SMajR			South		North		
6	North						WSS	NMajS		
7		SSR		WSR	WSR		SMajS	West	NMinS	NMinS
8			East	SMinR	SMinR				SSS	SSS
9			East	SMinR	SMinR		SMajS	West	NMinS	SSS
10				WSR	SMinR		WSS		SSS	SSS
11			East		WSR		WSS		SSS	SSS
12			East	SMinR	SMinR		SMajS	West	SSS	SSS
13				WSR	SMajR		SMajS	West	NMinS	NMinS
14		NMajR		WSR	WSR		SMajS	West	SSS	NMinS
15		NMajR	East				WSS	West	NMinS	NMinS
16		NMajR				South	WSS	West		
17	North	NMinR	SMinR	SMajR	SMajR	South			SSS	
18	North	NMinR	SMinR			South			NMajS	NMajS
19	North	SSR						NMinS		
20	North	SSR	SMinR			South	SMinS	NMinS	NMajS	
21	North	NMinR	WSR	SMajR		South		NMinS	NMajS	
22	North	NMinR	SMinR			South		SSS	NMajS	
23	North	NMinR	SMinR			South		SSS		
24	North	NMinR	SMinR					NMajS		
25		NMinR	SMinR					SSS		
26		NMinR	SMinR					SSS		
27		NMinR	SMinR					NMajS		
28	North	NMinR	SMinR					NMajS		
29	North	NMinR	WSR					SSS		
30	North	NMinR		SMinR				NMinS		
31			WSR					SSS		
32		NMinR						NMajS		
33	North	NMinR	SMinR					NMinS		
34	North	NMinR	SMinR					NMinS		
35					SMajR			NMinS		
36	North	NMinR	SMajR	SMajR				SSS		
37	North	NMinR	SMinR	SMajR	SMajR			SSS		

Note

For any pair of stones with adjacent stones on either side, the ten possible combinations of pairings from the central pair to all six stones are shown in Figure 2. These combinations are numbered clockwise 1-10 as azimuths from North starting at the northern diagonal and are the column headings in this Figure. The row headings identify the number of the stone pair positions 1-37. The azimuth bearings for zero horizon altitude at this latitude of 51° 25' for lunar standstills, the sun's solstices and cardinal alignments (not to be confused with equinoxes) are: North 0°/360°; Northern Major standstill moonrise (NMajR) 40.5°; Summer Solstice sunrise (SSR) 48°; Northern Minor standstill moonrise (NMinR) 59°; East 90°; Southern Minor standstill moonrise (SMinR) 121°; Winter Solstice sunrise (WSR) 129°; Southern Major standstill moonrise (SMajR) 141.5°; South 180°; Southern Major standstill moonset (SMajS) 218.5°; Winter Solstice sunset (WSS) 231°; Southern Minor standstill moonset (SMinS) 239°; West 270°; Northern Minor standstill moonset (NMinS) 301°; Summer Solstice sunset (SSS) 312°; Northern Major Standstill moonset (NMajS) 320.5°.

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## WHERE IS CULTURAL ASTRONOMY GOING?

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### Abstract

Archaeoastronomy has recently been characterised as 'going round in circles', failing to integrate a rapidly expanding body of data with the interpretive models of anthropology (Ruggles 2011). This paper locates some impediments to disciplinary growth in the legacy of our recent origins, a problematical conceptual vocabulary and a narrow and derivative theoretical base. Proposals are made for an alternative future for the discipline.

**Keywords** Archaeoastronomy, anthropology, archaeology, Thom.

At the 2011 Oxford IX conference in Lima Clive Ruggles characterised archaeoastronomy, after two decades of 'burgeoning' growth, as a discipline unable to ground its rigorous methodological practice within the testable hypotheses of interpretive anthropology. He argued that if we continue in this way as mere field workers, we will only ever be a service discipline to archaeologists and continue 'running round the same circles'. The way out of this rut, says Ruggles, is to locate archaeoastronomy hypotheses within anthropological, archaeological and historical theories and devise scientific tests to discriminate between possible interpretations (Ruggles 2011). Ruggles made the same observation twenty years ago when, together with Saunders, he commented that the future of archaeoastronomy lies in the multi-disciplinary integration of methods and theories to recover the meanings of ancient cosmologies. 'It is evident...that a serious problem in studying cultural astronomy is the lack of a rigorous methodology for combining evidence from...[these]...main disciplines...' (Ruggles and Saunders 1993, 15).

Arguably the situation is even more serious than this assessment. Adding molecular biology, linguistics and mythology to Ruggles' list, there has been nothing short of a

scientific revolution in our understanding of prehistory. Instead of seeing culture and society as beginning in the Neolithic with the agricultural 'revolution' in the Middle East, it is now clear that culture and social organisation begins with our Palaeolithic hunter-gatherer ancestors in sub-Saharan Africa. We now have at least six disciplines suggesting that monument building cultures are addressing issues of continuity and reversal with their forager origins. These six disciplines have separate datasets, methodologies, paradigms and, of course, scholars. The possibilities for devising tests by triangulation and emergence are large. A niche now exists within which archaeoastronomy can make a major contribution to scholarship by discriminating between these two diametrically opposed models of the Neolithic. If Ruggles is correct and, instead of embracing these exciting developments, for two decades epistemological issues have dominated at the expense of interpretation, this chronic condition cannot be the fault of these other disciplines. The answer must lie in archaeoastronomy itself.

When an organisation experiences impediments to further advance, then to understand why requires examining the legacy of that organisation's origins. The culture of modern archaeoastronomy has been and remains shaped by the repercussions of the work of Hawkins and Thom of half a century ago (Hawkins 1963, Thom 1971). Their claims that some prehistoric monuments were astronomical 'computers' and 'eclipse predictors' simultaneously inspired sections of the public and horrified most archaeologists. If the discipline was to survive this public over-enthusiasm and archaeological over-scepticism, then archaeoastronomers had to conduct a sober and scholarly re-assessment of these claims (Michell 1977, Ruggles 1999). Consequently over the last forty years archaeoastronomy has been mainly focussed on field work using the statistical method of testing the null hypothesis for claimed alignments at regional groups of monuments. Against this measure archaeoastronomy is now a matured scholarly discipline which has rebutted the earlier dismissal by many archaeologists that we do not have 'astronomical' data for prehistoric monuments and has also rejected some of the over-interpretation of these two 1960's iconoclasts.



However the reactive origins of the statistical method carried with it an over-adherence to this one method, a problematical conceptual vocabulary and a narrow and derivative theoretical base. As long as researchers buy into the conventional wisdom framed by these origins, all that can be achieved is to confirm what is already known – namely to continue to ‘run round the same circles’. Contrarily, for those prepared to question them by opening themselves up to anthropological and archaeological debates, there is the possibility for an inflationary expansion in our understanding of prehistoric ‘astronomy’. Let us look at the problems in method, vocabulary and theory within archaeoastronomy and the possibilities for transcending them.

Insofar that the statistical method is considered the only appropriate method for archaeoastronomy it automatically bars any possibility to reach the level of the meaning of prehistoric astronomical alignments. Testing the null hypothesis that any alignments claimed are unintentional chance occurrences will answer archaeological dismissal or undervaluing of archaeoastronomy, but by providing no guidance as to meaning it denies the discipline any interpretive ability – precisely where some archaeological critics want us (eg. Parker Pearson 2012, 46-8). It is only when the stage of testing the null hypothesis is completed that the real scholarly work needs to begin – devising tests between the competing anthropological, archaeological etc. theories as to what alternative ‘astronomical’ properties they would predict. The hard work involves constructing ‘critical experiments’ which generate opposite ‘astronomical’ predictions between competing theories (Stinchcombe 1968). Instead it has become customary within the discipline that at precisely this moment of the research process scholarly rigour is dropped for some ‘common sense’ interpretations. Thom variously suggested calendrical, tide and eclipse prediction as the reasons for prehistoric monument alignments. Today the most common suggestion has narrowed to calendrical interpretations. All of these ‘common sense’ interpretations derive from the assumptions of the now questionable Neolithic Revolution theory. Since it has been recognised by many for a long time (Heggie 1981, McCluskey 1998, Ruggles 1999) that none of these interpretations, and calendrical theory in particular, can explain either the details of monument architecture or the mass of labour power required in their construction, then

in continuing to espouse them we are not just going round in circles but going backwards. Tests for meaning come from theories of meaning, and as Ruggles indicates these come mainly from anthropology. Only by completing the scientific process of reviewing all the extant theories relevant to prehistoric monument building cultures and devising tests to discriminate between all of them will suggest what these meanings might be. Our discipline has not yet internalised this rigorous procedure which is standard in mature disciplines, and we suffer from a lack of internal peer review to enforce such a scholarly standard. This is one step that must be taken.

Statistical method is not the only legitimate method to rebut an over-sceptical critic of archaeoastronomy. Long ago Heggie (1981) pointed out that a unique monument such as Stonehenge with many known details of its architecture and from site excavation allows identifying features that could only be explained by an 'astronomical' alignment. If it can be shown that a whole suite of design features are only explainable by such an alignment, then critics must come up with some other explanation for those and more features, rather than level the accusation "*testis unus, testis nullus*" (Belmonte 2010). If the individualist error is true for Stonehenge, then it begs the question why Ruggles uses the very same method to explain the architectural feature of the roof box at Newgrange by a winter solstice sunrise alignment (Ruggles 1999). John North (1996) used this same method to test many archaeological hypotheses to great effect, yet within the discipline his work has not received the scholarly attention it deserves. It is not correct that such a procedure is less rigorous than statistically testing groups of monuments. The probability of all the design features of the Newgrange and the Stonehenge monuments accidentally combining to generate accurate windows of astronomical alignment can be calculated. At least three further methodologies are available to us. Monte Carlo modelling generates a pseudo-population of virtual alternatives to unique monuments such as Newgrange and Stonehenge, and statistical testing can then calculate the probability of random alignments compared to those actually found (Hively & Horn 2006). Landscape phenomenology can be quantified to treat a local region as an area of alternative sites for a given single monument, and the astronomical properties of the actual chosen site can be compared with all of the

qualitatively different possible alternative sites (Sims 2009). And computer modelling with the integration of accurate renditions of monument, its landscape and skyline for relevant dates can provide a test-bed for alternative hypotheses. Instead of clinging to the disciplinary boundary battles of decades ago, those who led that struggle need to champion this battery of methods while steering the discipline towards ethnographic interpretation. This is a second step that must be taken.

We suffer from a problematical conceptual vocabulary, particularly with respect to the moon (see Lebeuf 2007). The large question, which is rarely asked, is why Neolithic 'astronomy' on lunar horizon limits replaced Palaeolithic 'astronomy' on direct observation of lunar phases (Marshak 1972). To answer that question requires untangling all the properties of lunar standstills and at present just two are identified – solstice luminosity and horizon range.

With respect to the first issue, Ruggles has shown that five regional groups of Neolithic monuments in the British Isles have axial alignments towards the south west onto the winter solstice sunset and major or minor standstill moonsets, yet when discussing these he labels them 'anomalous' (Ruggles 1999). Of course data cannot be anomalous – only certain theories make classes of observations 'anomalous'. And it is because Ruggles is wedded to the view that any alignment on the moon must invariably be upon *full moon*, and since this takes place 13-14 days later on the north west horizon during the winter or six months earlier in a standstill year, this would make a winter south west horizon alignment 'anomalous'. Further, a lunar standstill is more than just a horizon range limit, no matter which of the eight horizon limiting positions it occupies. Unlike the sun's solstices which last at least a week twice a year, a lunar standstill is spread over the course of one year twice every nineteen years. Morrison (1984) showed that all phases of the moon displayed in one synodic month will be represented during a standstill, but now attenuated over the course of year in sidereal time-lapsed intervals and in reverse order (Sims 2006). The property of a lunar standstill as a time-lapsed reversed phase sequence is hardly ever considered. As Heggie pointed out many years ago, there is no particular reason why full moon rather than any of the other twelve or so

phases would have been the one chosen by monument builders to align their monuments upon since *all* phases are represented on the same standstill alignment over the course of a standstill year. But since the monument alignments found by Ruggles are on the southern standstills this synchronises dark moon not full moon with the winter solstice. To choose the luminosity of full moon rather than these ‘anomalous’ alignments to the south west on winter solstice dark moon strongly suggests a predilection towards luminosity and solarist assumptions. While that may be understandable for modern astronomers, it is an ethnocentric preconception when interpreting prehistoric rituals.

With respect to the second issue, of the two types of lunar standstill that occur within the 18.61 year draconic cycle discussion is usually limited, just as with Thom, to the major standstill. This is preferred since it is assumed that the large horizon swing of the moon’s rises and sets *outside* of solar horizon range qualifies it as some ‘super-sun’, which then undermines discussion on the equally represented minor standstill whose range limits are *within* the sun’s horizon range. The question not asked is what is *common* to both standstills during winter settings when we have set aside the horizon azimuths of each? Instead we continue with Thom’s allegiance to the major standstill at the expense of the minor standstill, and fail to answer the questions asked by Heggie over thirty years ago. As Morrison showed, southern standstills, whether major or minor, synchronise dark moon with winter solstice and northern standstills, whether major or minor, synchronise dark moon with summer solstice. A thorough assimilation of the initial debate begun by Heggie is required to test the validity of lunar standstill as solstice luminosity, horizon range or as an annualised ‘month’ of lunar phases reversed and culminating in a solstice dark moon. This is a third step that should be taken.

Some recent field work in archaeoastronomy has broken through this circle of solarist assumptions and belies a blanket belief that we are only marking time. Many Iberian tombs have been shown to be aligned not upon the sun, as earlier thought, but upon the crossover of the sun and the moon in their annual alternation along the horizon (Da Silva 2004, Silva & Pimenta 2012). This is further evidence for a lunar-solar cosmology

in prehistory, for in addition to the alignments for horizon range limits for lunar standstills found in NW Europe, this reveals equinox 'crossovers' in southern Europe. This is associated with another property of lunar standstills not limited to their horizon range limits, since the equinox crossover full moon is *a/ways* eclipsed during a standstill year, both major and minor. It may be that if crossover alignments were selecting for these lunar eclipse events, then this would have been another way of marking a standstill year, and is true for both major and minor standstills. This new concept within archaeoastronomy is consistent with the requirement that to continue a hunter-gatherer lunar phase locked ritual system within a trans-egalitarian agro-pastoral society they could be displaced from lunar to lunar-solar cycles with these two types of monument standstill alignments.

The greatest impediment to our ability to interpret our field data are the derivative theories we mobilise in conferences and publications. The most common theory mobilised by archaeoastronomers is a version of the Academy School archaeological theory of the Neolithic Revolution – that Neolithic monuments are sites of agriculturalist funeral rituals that are foundational of culture (Childe 1964, Renfrew 2001). This theory affords no significance to precursor rituals of hunter-gatherers, and narrows the 'social field of the sky' (Iwaniszewski 2011) and the 'external history' (McCluskey 2011) to calendrical markers for unspecified funeral ritual content. It ignores the transition of monument builders' culture from their forager ancestors, therefore disenfranchising any contribution from anthropology, and thereby relegates archaeoastronomy to the same service role that Ruggles identifies as the impediment to our growth.

The new models of prehistory that we now have predict that monument building cultures of the Neolithic have their precursors in their Palaeolithic hunter-gatherer ancestors – Palaeolithic Continuity/Refugia theory (Frank 2008). Gobekli Tepe is only the latest evidence for this (Schmidt 2010). There are good reasons to suspect that their socio-economic life was ritually constructed upon a lunar template (Marshak 1972, Knight 1991). Once with the mass extinction of mega-fauna at the end of the Palaeolithic the collapse in logistical big game hunting began, there are just a few survival strategies

that are possible - continue hunting but now in small mobile bands pursuing small game, sedentary hunters storing seasonal runs of masses of small game such as salmon or eels, pastoralism and horticulture/agriculture. While these were frequently combined in a highly variable mix (Thomas 1999), none of them can singly or in combination synchronise production with a lunar template as could Palaeolithic big game hunting. If this model is correct, then it would predict that a lunar transformational template would be modified by local and regional groups to both preserve, modify and reverse Palaeolithic ritual components. It would generate a type of 'periodic table' of astronomical elements in which lunar symbols would at first be combined with solar, or planetary and or astral properties so that ritual time could be stretched, displaced and reversed outside a monthly timescale. Bracketing lunar phases with solstices is achieved by lunar-solar monument double alignments on standstills and solstices. Or, for example, Venus, called 'little moon' by the Ona/Yaghans in Tierra del Fuego (Lucas Bridges 1949, Coon 1977), and as evening star and morning star throughout the Americas, carries similar attributes to waxing and waning crescent moons. Cosmologies that appear to be calendrical to us will carry extra-calendrical properties that reveal an ancient lunar infra-structure that governed the triggering of the sacred domain. The greater the remove from its Palaeolithic roots, the greater the in-egalitarian and patriarchal developments, the more the lunar dimension will be hidden at the expense of alternative cosmic markers. But just as in the modern west we still have a synodic ritual of a human/god sacrificial blood ritual at the eclipsed full moon after the equinox, so similarly we would expect traces of that ancient lunar infra-structure. This is a model. Whether it is correct or not needs to be tested. During such testing concepts like reversal, manipulation and subterfuge, which are especially prominent in anthropological models of cosmology, may well be useful in interpreting our 'astronomy' data. Archaeoastronomy is ideally suited to provide game-changing tests which other disciplines cannot.

What do we need to do to avoid 'running round in circles'? Others will have their own suggestions, but I recommend this list as a way to start the debate:

1. Act on Ruggles challenge and engage with anthropology, archaeology etc. and devise tests for meaning of prehistoric monument alignments. Our conference and published papers should be driven by enumerating the main interpretive models from other disciplines and building research designs that test each. Conference organisers should supportively encourage this.
2. Put our own house in order and build a scholarly consensus around what is valid and robust in the works of Thom in particular, and others such as Hawkins and North. I would argue that requires reading or re-reading Heggie.
3. We need to integrate our discipline around a peer-reviewed common stock of knowledge. Until this is achieved our own research will remain disparate and competitive rather than cumulative.
4. Encourage a reflexive debate on the strengths and weaknesses of the statistical method, and its place within a wider engagement with additional methods including unexplained monument design features, Monte Carlo modelling, a quantified landscape phenomenology and virtual modelling.
5. We need to see ourselves through the eyes of the other and hear how we are evaluated by cognate disciplines. At Granada we shared our conference with physicists. We also need to share them with archaeologists, anthropologists etc. who have a *direct* interest in cultural astronomy.
6. We should have conference round table workshops for collective reviews of crucial current debates highlighted during each conference. Each conference workshop should judge how our discipline is progressing.
7. Since the main interpretive disciplines that we must engage with are anthropology, archaeology etc., then we should be presenting papers at their conferences and publish in their journals.
8. Presently there are very few educational programmes in archaeoastronomy and cultural astronomy – according to one count just one MA module at the University of Wales Trinity Saint David and one PhD Programme at Tbilisi. We should launch a vigorous outreach policy which could include: short courses like summer schools for active researchers in other disciplines, especially

archaeology and anthropology; distance learning programmes for novice researchers.

9. Aim to establish systems for SEAC to kite mark cultural astronomy courses as they come on stream.

Ruggles decades-old concern for integration with anthropology to reach the level of meaning of our field data must be our aim. The opportunity exists for archaeoastronomy to be a keystone discipline in the intellectual arch of cognate disciplines whose task it is to reconstruct our past. This is one possible future as an alternative to the danger we face pointed out by Ruggles. The alternative is to remain side-lined in our present tiny niche in academia.

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