An Undergraduate-level Learning Resource

Transcript of Archaeoastronomy Course, University of Leicester, 2003

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For information and as a resource, we offer the complete archaeoastronomy course material online here as it was given to students in the spring term 2003. The introduction follows below, or you can use the navigation on the left to browse the course content.

Course AR3015: An Introduction to Archaeoastronomy

Archaeoastronomy has emerged in the last three decades as a thriving 'interdiscipline', but it is one that continues to be viewed with suspicion by many mainstream archaeologists.

Together with what has become known as ethnoastronomy or cultural astronomy, it strives to comprehend the nature and meaning of astronomical practice in past (as well as modern non-Western) societies. This has tended to be of particular interest to astronomers and historians of science, but for the archaeologist or anthropologist forms merely one aspect of the study of human societies in general. It is an important one, though: the movements of the heavenly bodies are of almost universal concern, even amongst small bands of hunter-gatherers. Stellar lore and astronomical practice invariably form part of a broader frameworks of understanding--cosmologies--which define and dictate the nature, place and timing of various human actions.

Archaeoastronomical investigations involve the integration and interpretation of evidence from widely ranging fields such as archaeology, history, anthropology, astronomy, and statistics, and require a well-developed critical perspective in all of them. This in itself raises some fascinating methodological issues: differences of approach, misunderstandings and ignorance lay behind many of the interdisciplinary conflicts of the 1960s and 1970s concerning Stonehenge and "megalithic astronomy", and many other controversies that have arisen since then.

The course will focus upon questions of archaeoastronomy's aims and objectives, scope and methodology, and its place (if any) within modern archaeology and anthropology as a whole. The first part of the course will concentrate on the Neolithic and Bronze Age in Britain and Ireland, and particularly on the interpretation of astronomical symbolism in monumental architecture. The remainder of the course will draw upon numerous examples from world archaeoastronomy and ethnoastronomy. Basic astronomical concepts will be introduced in the course of the first few lectures, but the course as a whole

will not concentrate upon technical details.

The general aims of the course are:

- to introduce you to the scope of problems addressed by archaeoastronomy;
- to introduce you to the methodological principles and conflicts involved in archaeoastronomy;
- to help you develop a critical understanding of the role of archaeoastronomy within archaeology; and
- to help you develop an appreciation of the value and problems of highly interdisciplinary studies.

By the end of the course you should have:

- an appreciation of the type and range of issues that archaeoastronomers strive to address;
- a basic understanding of the principal concepts and techniques used in archaeoastronomy;
- a basic understanding of the appearance of the night sky and the general principles of the diurnal, annual and longer-term motions of the celestial bodies; and
- an appreciation of the theoretical and methodological conflicts that arise through the clash of different disciplinary perspectives in this field, and the attempts that have been made to resolve them.

Course AR3015: An Introduction to Archaeoastronomy

Lectures take place on Thursdays at 1.30-3.30 in Astley Clarke 10, except where otherwise stated.

Welcome and Introduction to Course

Week 15, Jan 30 Introductory session--timetable, books, use of Web. The nature and development of archaeoastronomy
Astronomy in prehistoric Britain and Ireland

Week 16, Feb 6 Sun, moon and stones: the arguments surrounding "classic" astronomical sites

Week 17, Feb 13 Going for groups: looking for trends in groups of monuments

Week 18, Feb 21Archaeoastronomy in Britain and Ireland: key ideas, issues and themes [Part 1]
NB This lecture is on FRIDAY at 12.30-2.30 in Room FJ 1119.

Week 19, Feb 27 Planetarium session followed by: Archaeoastronomy in Britain and Ireland: key ideas, issues and themes [Part 2]

Week 20, Mar 6 SEMINAR: Interpretation and explanation: the social context of astronomy in prehistoric Britain and Ireland (seminars)
World Archaeoastronomy

Week 21, Mar 13 European archaeoastronomy: orientations of tombs, temples and churches

Week 22, Mar 20 The rise of American archaeoastronomy and the 'green' v. 'brown' methodological divide

Week 23, May 1 Integrating evidence from art and ethnohistory

Week 24, May 8 Astronomy in context: case studies from modern indigenous groups

Week 25, May 15 SEMINAR: Theory and method in archaeoastronomy: key issues (seminars)

And finally...
Week 26, May 22 Field trip to the Peak District

Lecture 1: The nature and development of archaeoastronomy

Objectives
To introduce archaeoastronomy through its "social history", from the Stonehenge and "megalithic astronomy" controversies of the 1960s and 1970s, the rise of "world archaeoastronomy" in the 1970s and 1980s, and its position relative to mainstream archaeology today.

Main reading
Introduction from *Astronomy in Prehistoric Britain and Ireland*

Bibliography

"Historical" background
Stonehenge and Other British Stone Monuments Astronomically Considered. J. Norman Lockyer. (Macmillan, 2nd. edn. 1909). The first scientific investigation of astronomical alignments at British prehistoric ritual monuments, by the astronomer editor of the journal "Nature".

Stonehenge Decoded, G.S. Hawkins and J.B. White (Fontana 1965). The cult book of the 1960s, and an invaluable insight into the nature of some of the material fuelling the controversies of the 1960s.

"Moonshine on Stonehenge." Richard Atkinson, *Antiquity*, 40 (1966), 212-16. Atkinson's reaction to Hawkins' book. A killer!

"Speculations on Stonehenge." Fred Hoyle, *Antiquity* 40 (1966), 262-76. The professional astronomer enters the debate.

"God in the machine". Jacquetta Hawkes, *Antiquity* 41 (1967), 174-80. Further reaction to Hawkins and Hoyle.

Megalithic Sites in Britain, A. Thom (OUP 1967); *Megalithic Lunar Observatories*, A. Thom (OUP 1971). Alexander Thom's first two books, technical and making few concessions to those who cannot cope with mathematics. Worth glancing at to see the nature of the material with which archaeologists were faced in the 1970s, and to assess their reaction.

From Stonehenge to Modern Cosmology. Fred Hoyle (Freeman, 1972); *On Stonehenge*. Fred Hoyle (Heinemann, 1977). Fred Hoyle's books in which his theories of Stonehenge are developed in detail.

`The place of astronomy in the ancient world', *Philosophical Transactions of the Royal Society*, A276 (1974). Papers from a joint meeting of the British Academy and Royal Society held in 1972. One of the first meetings to draw together contributions on ancient astronomy worldwide.

'Megalithic astronomy--a prehistorian's comments.' *Journal for the History of Astronomy* 6 (1975), 42-52. Atkinson's reactions to Thom's work; rather different from his reactions to Hawkins' ten years earlier!
Science and Society in Prehistoric Britain, E.W. MacKie (Paul Elek 1977). Controversial book by an archaeologist who, against the trend of his colleagues, took fully on board the ideas of Thom about ancient astronomy and geometry and explored the social implications. See also MacKie's paper in Ruggles & Whittle (below), where he attempts to stave off the barrage of criticism.

Astronomy and Society in Britain during the period 4000-1500 BC, ed. C.L.N. Ruggles & A.W.R. Whittle (BAR 88, 1981). The Proceedings of a conference at which both sides in the `megalithic astronomy' debate met and exchanged views. A collection of papers from a diverse set of viewpoints.

"Archaeoastronomy and ethnoastronomy so far", by Elizabeth Chesley Baity.*Current Anthropology* 14 (1973), 389-449. A wide overview of work on astronomical practices in past and present non-Western societies.

Archaeoastronomy in the Old World, ed. D.C. Heggie (CUP 1982). The first of two volumes of Proceedings from the first `Oxford' International Conference in Archaeoastronomy, held in 1981. The "green" book.

Archaeoastronomy in the New World, ed. A.F. Aveni (CUP 1982). The second `Oxford 1' volume. The "brown" book.

Another book that is worth a look is *Records in Stone*, edited by Clive Ruggles (CUP 1988), which has just been reprinted in paperback. This "posthumous festschrift" to Alexander Thom gives a good impression of the wide range of perspectives and

approaches that were being applied in British archaeoastronomy in the 1980s. There are contributions by archaeologists, astronomers, engineers, and a range of serious amateurs, as well as comparative perspectives by two Amercian archaeoastronomers.

Some recent publications and controversies
Stonehenge: Neolithic Man and the Cosmos, by John North (HarperCollins, 1996), and reviews by Anthony Aveni (*Nature*, 383 (1996), 403-404) and Clive Ruggles (*Archaeoastronomy* no. 24(supplement to *Journal for the History of Astronomy* 30) (1999), S83-88).

"Cosmology, calendars, and society in Neolithic Orkney: a rejoinder to Euan MacKie", by Clive Ruggles and Gordon Barclay, *Antiquity* 74 (2000), 62-74. A response by Euan MacKie is available on the *Antiquity* web site here, with a summary in *Antiquity* 76 (2002), 666-668; and there is a further response by Ruggles and Barclay on pages 668–71.

OTHER SOURCE MATERIAL
For some of the most recent source material, consult the *Archaeoastronomy* supplement to *Journal for the History of Astronomy* (this is filed in the library under history of astronomy as well as Archaeology) and the journal *Archaeoastronomy: The Journal of Astronomy in Culture* published by the University of Texas Press.

Lecture 2: Sun, moon and stones: the arguments surrounding "classic" astronomical sites

Objectives
To introduce some fundamental issues of methodology.

To introduce some of the basic astronomical concepts.
This is done through case studies of five monuments that have been intensively discussed in the context of prehistoric astronomy: Newgrange, Ballochroy, Kintraw, Minard (Brainport Bay), and Le Grand Menhir Brisé (Carnac).

Main reading
Chapter 1 in *Astronomy in Prehistoric Britain and Ireland*
Further information and supporting materials

Newgrange

The definitive book on the excavations, which has a full account of the midwinter surise phenomenon and the roofbox, is *Newgrange: Archaeology, Art and Legend*, by Michael O'Kelly (Thames and Hudson 1982). Alternatively, see Claire O'Kelly's *Illustrated Guide to Newgrange* (John English, Wexford, 1967, 1971 & 1978).

For an interpretation of the designs carved on the roofbox as solar symbols, see pp 132-3 of Rodney Castleden's *The Making of Stonehenge* (Routledge 1993).

For a more extensive, and individualistic, astronomical interpretation of the megalithic art at Newgrange and elsewhere, apply a critical eye to: *The Stars and the Stones: Ancient Art and Astronomy in Ireland*, by Martin Brennan (Thames and Hudson 1983).

Photos of Newgrange
Take a look at a web resource that describes some detailed investigations into Newgrange and its solar alignment. Click here, here and here, and use the "Back" button on your web browser to return to this page afterwards.

Ballochroy

The original astronomical account of Ballochroy by Thom was published in 1954, in the *Journal of the British Astronomical Association* (vol 64, pp. 396-404). For commentary by an astronomer see Douglas Heggie's *Megalithic Science* (Thames and Hudson, 1982).

For archaeological critiques see pp. 176-8 of MacKie's paper in *The Place of Astronomy in the Ancient World* (see Lecture 1 info.) and ch. 2 of Aubrey Burl's *Prehistoric Astronomy and Ritual* (Shire 1983 & 1997). (This is a short but useful introduction to a number of the topics covered in the first two or three lectures.)

Photos of Ballochroy

Kintraw

For MacKie's account of his excavation to test Thom's astronomical hypothesis, see pp. 178-85 of MacKie's paper in *The Place of Astronomy in the Ancient World"* (see Lecture 1 info).
For critiques see pp 211-5 of Jon Patrick's paper in *Astronomy and Society* (see Lecture 1 info) and McCreery et al.'s paper in *Archaeoastronomy in the Old World* (see Lecture 1 info).

Photos of Kintraw

Minard (Brainport Bay)

This enigmatic collection of structures--artificially enhanced platforms, standing stones, cup-marked stones and other features--was brought to prominence in the "megalithic astronomy" debate by Euan MacKie, who believed it to be a prehistoric calendrical complex. It raises a number of methodological issues to do with procedures for testing astronomical ideas using archaeological techniques, and whether this is the best way to proceed in the first place.

A detailed critique is contained in Chapter 1 of *Astronomy in Prehistoric Britain and Ireland.* I didn't show many photos of Minard in the lecture, and these will supplement the ones in the book.

What is most striking about Brainport Bay is that a number of stone structures occur in a single NE-SW alignment. These were explored from 1976 onwards by members of the mid-Argyll Archaeological Society. Euan MacKie's attention was first drawn to the site in 1976. For his early ideas in relation to the 'main alignment' see MacKie's paper in *Astronomy and Society*, ed. Ruggles and Whittle (BAR88, 1981) 131-4. The argument was extended later when he explored features in the vicinity of a standing stone at Oak Bank (see MacKie, Euan W., Fane Gladwin, P. and Roy, Archie E. (1985). "A prehistoric calendrical site in Argyll?" *Nature* 314, 158-61); MacKie's chapter in *Records in Stone*, ed. Ruggles, CUP 1988.

Le Grand Menhir Brisé

Could the backsights have arisen by chance? For different points of view see Jon D. Patrick and C.J. Butler, "On the interpretation of the Carnac menhirs and alignments by A. and A.S. Thom*", Irish Archaeological Research Forum*, 1(2) (1974), 29-39, p. 30; Richard Atkinson, "Megalithic astronomy: a prehistorian's comments", *JHA* 6 (1975), 42-52, pp. 44-5; Peter R. Freeman, "Carnac probabilities corrected", *JHA* 6 (1975), 219.

But for a definitive critique of Thom's ideas see Evan Hadingham, "The lunar observatory hypothesis at Carnac: a reconsideration", *Antiquity* 45 (1981), 35-42. On whether the great menhir ever actually stood, or fell during erection, contrast Robert L. Merritt and Archibald S. Thom, "Le Grand Menhir Brisé", *Arch. J.*, 137 (1980), 27-39, and R. Hornsey, "The Grand Menhir Brise: megalithic success or failure?", *Oxford J. Arch*. 6(2) (1987), 185-217.

Basic astronomical concepts

Several books contain reasonable accounts of the background concepts introduced in the lecture, but most also go into a lot of technical detail unnecessary for our purposes. For a short explanation of declination, see Astronomy Box 1 in *Astronomy in Prehistoric Britain and Ireland*. For a short and simple explanation of the motions of the sun and moon, see pp 220-1 of Christopher Chippindale's *Stonehenge Complete* (Thames and Hudson, 2nd edn, 1994). For fuller explanations, see other Astronomy Boxes in Chapter 1 of *APBI*.

Lecture 3: Going for groups: looking for trends in groups of monuments

Objectives

To introduce you to some simple probability arguments and their potential strengths and their weaknesses.

To introduce you to arguments involving archaeoastronomical evidence from groups of monuments, and to give you an adequate basis to assess their strengths and limitations.

Main reading
Chapter 1 in *Astronomy in Prehistoric Britain and Ireland*, from p. 35 (Stonehenge);
Chapter 5 in *Astronomy in Prehistoric Britain and Ireland*

Further information and supporting materials

Stonehenge: sun, moon and probability
The probability arguments that are at the core of Hawkins' assertion that Stonehenge incorporated numerous deliberate solar and lunar alignments, are contained in his paper published in *Nature* in 1963 and reproduced as Appendix A of *Stonehenge Decoded* (see Lecture 1 info.). For a critique see pp. 148-151 of Douglas Heggie's *Megalithic Science* (Thames & Hudson, 1982) as well as pp. 42-43 of *Astronomy in Prehistoric Britain and Ireland*.

More generally about mid-twentieth-century ideas about Stonehenge astronomy, deriving from Newham, Hawkins, Hoyle etc: there are numerous discussions and critiques, but see especially Heggie's *Megalithic Science*, which gives a critical discussion from the point of view of an astronomer. The first edition of Chippindale's *Stonehenge Complete* (Thames and Hudson, London, 1983) discusses Stonehenge astronomy in some detail (pp. 216-35), but this is considerably cut down in ch. 14 of the 1994 edition as it is "no longer a current affair" (p. 276). See also Rodney Castleden's *The Making of Stonehenge* (Routledge, 1993), pp. 18-27.

Full reports on excavations at and around Stonehenge in this century have finally appeared in Cleal, Walker and Montague, *Stonehenge in its Landscape: Twentieth-century Excavations*, English Heritage (English Heritage Archaeological Report 10), London, 1995.

More on Stonehenge in a later lecture.

Thom's "megalithic astronomy"
In the course we do not consider the work of Alexander Thom and its reassessment in any detail, partly because the topic is a very technical one and partly because many of the issues are no longer of current archaeological interest. However, it is worth skimming through Chapters 2 and 3 of *Astronomy in Prehistoric Britain and Ireland*, and you should at least read the first and last sections of Chapter 2 and the first and last two sections (from 'Lessons Learned' onwards) of Chapter 3.
Fun time!
And, while you're at it, why not see if you can identify the four foresights at the Brodgar "lunar observatory"....

Local groups of similar monuments
Chapters 5 and 6 of *Astronomy and Prehistoric Britain and Ireland* include all the pointers you need to further reading.

Recumbent stone circles
The Scottish RSCs are one of the most important local groups of monuments in archaeoastronomy as they manifest a consistent symbolic relationship with the midsummer full moon. For a full discussion see *APBI* Chapter 5 up to p. 99. See also Aubrey Burl's *The Stone Circles of Britain, Ireland and Brittany* (Yale University Press, 2000).
On the web: Richard Bradley's recent excavations at Tomnaverie: see here and here.
Photos of recumbent stone circles

Axial stone circles
These are type of stone circle found in the south-west of Ireland distinguished by having a recumbent, or axial, stone around SSW and two high uprights, or "portals" placed on the opposite side. Their similarity in form to the Scottish recumbent stone circles has led to them also being termed "recumbent stone circles" by some authors. They are generally smaller than the Scottish RSCs, some consisting of only five stones in total. See *APBI* Chapter 5 from p. 99.
Photos of axial stone circles

Short stone rows
See *APBI* Chapter 6. Also known as "stone alignments", these are rows of up to six standing stones set up in parts of Britain and Ireland, with particular concentrations in western Scotland, northern Ireland and south-western Ireland, erected between about 3000 and 1500 cal BC. *Stone Rows* by A. Thom, A.S. Thom and A. Burl (BAR International Series S560, 1990, in two volumes) and *From Carnac to Callanish: The Prehistoric Stone Rows and Avenues of Britain, Ireland and Brittany*, by Aubrey Burl (Yale University Press, 1993) both contain full gazetteers.
Photos of south-west Irish short stone rows
Photos of western Scottish short stone rows
Short stone rows of Britain and Ireland: further examples

"The general v. the specific"
I used the example of the Clava cairns to illustrate the question of how we balance statistical evidence from trends at local groups of monuments against broader contextual evidence from single sites. See also Richard Bradley's *The Good Stones: A New Investigation of the Clava Cairns* (Society of Antiquaries of Scotland monograph series no. 17, 2000), especially p. 126.
On the web: Richard Bradley's excavations at Balnuaran of Clava: see here.

The general theme is developed in my paper "The general and the specific", *Archaeoastronomy: The Journal of Astronomy in Culture* (University of Texas Press), 15 (2000), 151-177. This article broadens the discussion to take into account, for example, Mesoamerican case studies, but might be worth a read at this stage of the course.

Lectures 4 & 5: Archaeoastronomy in Britain and Ireland: key ideas, issues and themes

Objectives

To familiarise you with some of the claims relating to astronomy that have appeared recently in the mainstream archaeological literature, and to introduce you to some of the interpretative issues that they raise.

The case studies will be arranged roughly chronologically and span the Neolithic through to the Iron Age.

Main reading

Chapter 8 in *Astronomy in Prehistoric Britain and Ireland*.

Further information and supporting materials

Neolithic and Bronze Age Britain and Ireland

See chapter 8 of *APBI* for pointers to detailed references on particular topics covered here. For a shorter overview see my chapter in *Prehistoric Ritual and Religion*, edited by Alex Gibson and Derek Simpson (Sutton, 1998).

On patterns of formal deposition at Stonehenge, see Joshua Pollard and Clive Ruggles, "Shifting perceptions: spatial order, cosmology, and patterns of deposition at Stonehenge", *Cambridge Archaeological Journal*, 11(1) (2001), 69–90.

A recent publication relevant to a number of issues raised in the lecture is the paper by myself and Gordon Barclay entitled "Cosmology, calendars and society in Neolithic Orkney: a rejoinder to Euan MacKie" in *Antiquity*, 74 (2000), 62–74.

Photograph of the "Slaughter Stone" and Heelstone at Stonehenge Copyright © Graeme Barker

Astronomy and Landscape

Although not covered in any detail in lectures, the question of how astronomical concerns relate to broader issues of landscape perception and the spatial correlates of human activity in the landscape, including monument construction, is well illustrated by the North Mull project which is covered in some detail in Chapter 7 of *APBI*. See also these pictures. Also relevant to these questions is the mid-Ulster complex of stone circles and rows, a preliminary report on which can be found in pp. 51-71 of *Astronomy, Cosmology and Landscape* (see Core texts).

The Iron Age and beyond

On Fiskerton, a popular article by Mike Pitts entitled "Altar of the Druids" appeared last year in *New Scientist* (16 Feb 2002). One of our Masters students (Serena Fredrick) worked on the problem for her dissertation project last summer. The archaeological report on the site is *Fiskerton: Iron Age Timber Causeway with Iron Age and Roman Votive Offerings* by Naomi Field and Mike Parker Pearson (Oxbow Books, 2002).

Seminar session 1

The main aim of the session is to have a broad-based discussion focussing on issues of interpretation and explanation. There will be three teams, each of whom will take a

paper which mentions astronomical alignments, but contextualised in a broader discussion of monuments and landscape. The three papers all come from the recent book *Monuments and Landscape in Atlantic Europe*, edited by Chris Scarre (Routledge, 2002) and are:

- On recumbent stone circles, by Richard Bradley
- On Cork-Kerry megaliths, by William O'Brien
- On Neolithic monuments in Brittany, by Chris Scarre

The central question to consider is: how does archaeoastronomy fit into these authors' broader interpretations of a set of monuments? For example, you might consider:

- How does each author claim that astronomical alignments might have arisen?
- How do they go about recognising them?
- How do they assess their significance?

Each team of three people will lead the discussion with short presentations in a format of their choosing, but there will be plenty of time for a debate to lead on from there.

I hope to be feeding in and clarifying issues, but primarily I want to get you all thinking, so the floor is yours rather than mine and I aim to be doing as little talking as possible!

Lecture 6: European archaeoastronomy: orientations of tombs, temples and churches

Objectives

To familiarise you with some of the claims relating to astronomy that have appeared within continental Europe and over a much broader chronological period than we have considered so far.

The case studies are chosen so as to raise interpretative issues of a different nature from those we have encountered so far.

Main readings

Chapter 8 in *Astronomy in Prehistoric Britain and Ireland*.

Michael Hoskin, *Tombs, Temples and their Orientations* (Ocarina, 2001).

Steve McCluskey, *Astronomies and Cultures in Early Medieval Europe* (Cambridge UP, 1998).

Stanisław Iwaniszewski, "Archaeoastronomy in traditional areas of Eurasia: a review paper", *Archaeoastronomy: The Journal of Astronomy in Culture*, 14(2)(1999), 87-127.

Further information and supporting materials

The Abri Blanchard bone
The original commentary appeared in Alexander Marshack's *The Roots of Civilization*, first published in 1972. For some references to Marshack's ideas and critiques of them, see notes 6 and 7 on page 244 of *Astronomy in Prehistoric Britain and Ireland*. A reference is also given there to claims that there might be British examples of Upper Palaeolithic bones with series of incised markings, but see F. d'Errico, C.T. Williams and C.B. Stringer, "AMS dating and microscopic analysis of the Sherborne bone", *J. Arch. Sci.*, 25 (1998), 777-87.

On the web: A general web page on archaeoastronomy featuring a commentary on the Abri Blanchard bone: see here .

Orientations of tombs and temples in Mediterranean Europe
The seminal work here is Michael Hoskin's book. This extends the short discussion in the paragraph spanning pages 125-6 in *APBI* and sets orientation patterns in British and Irish Neolithic and Bronze Age monuments in a considerably broader European context. Based on data from over 3000 later prehistoric tombs and temples, it can leave nobody in any doubt that orientation is a hugely significant factor in trying to interpret these monuments
.

The Politicization of Archaeoastronomy in Europe
The most notorious episode in this regard, the appropriation of archaeoastronomy in support of the nationalist agenda in Nazi Germany, is well described on pp. 58-65 of John Michell's *A Little History of Astro-archaeology* (Thames and Hudson, 1989).

The Coligny Calendar
On pre-Roman calendrical rituals and their Christianisation, and on the Coligny calendar, see Chapter 4 of *Astronomies and Cultures in Early Medieval Europe*.

Lecture 7: The rise of American archaeoastronomy and the "green" v. "brown" methodological divide

Objectives

To give you an understanding of the context within which American archaeoastronomy emerged in the 1970s, and in particular its theoretical and methodological starting points and how they differed from "megalithic astronomy" in Britain.

To identify some of the fundamental issues at the heart of the "green" v. "brown" methodological debate of the 1980s.

After a general introduction to Maya astronomy and the Mesoamerican calendar, Mesoamerican archaeoastronomy is introduced through the search

for observing instruments: the caracol at Chichen Itza and zenith tubes at Monte Alban and Xochicalco. We shall then discuss two case studies which highlight key methodological issues: the Venus alignment of the Governor's Palace at Uxmal; and the function and meaning of the pecked-cross circles at Teotihuacan.

Further information and supporting materials

On the general archaeological background to Mesoamerica there are several books in the library, such as *The Archaeology of Mesoamerica*, ed. Warwick Bray and Linda Manzanilla, British Museum Press, London, 1999.

Maya astronomy and the Mesoamerican calendar
On the Maya generally, see Michael Coe's *The Maya*. The 4th edn. was published in 1987. The last chapter covers Maya cosmology, numbers, astronomy and calendrics. For a classic account of Maya astronomy see Thomson in *The Place of Astronomy in the Ancient World*, Phil. Trans. R. Soc. Lond. A276 (1974), 83-99. There is also an excellent introduction entitled "Maya astronomy: what we know and how we know it", by Barbara Tedlock, in *Archaeoastronomy: The Journal of Astronomy in Culture*, 14(1), 39-58.

For a detailed and accessible account of Mesoamerican calendrics see chapter 4 of Anthony Aveni's *Skywatchers* (University of Texas Press, 2001). See also chapter 6 of Aveni's *Empires of Time* (Basic Books, 1991).

Background astronomy
On the motions of Venus see *Skywatchers* pp 80-84.

Between the tropics, the sun's path passes directly overhead twice during the year. For a table showing the dates of zenith passage at different latitudes see *Skywatchers*, p. 67.

Archaeoastronomy at Chichen Itza, popular and more serious
On the equinox shadow effect at El Castillo, see the paper by John Carlson in *Archaeoastronomy: The Journal of Astronomy in Culture*, 14(1), 136-52. On the Caracol at Chichen Itza as a possible observatory, see *Skywatchers*, pp. 272-9.

Photos of El Castillo
Photos of The Caracol

Zenith tubes at Monte Alban and Xochicalco
On the zenith tubes at Monte Alban and Xochicalco see Anthony Aveni and Horst Hartung, "The observation of the sun at the time of passage through the zenith in Mesoamerica", *Archaeoastronomy* no. 3 (*JHA* 12, 1981), S51-70. See also *Skywatchers* pp. 265-70.

Photos of Monte Alban and its zenith tube
Xochicalco and its zenith tube

The Venus alignment at the Governer's Palace, Uxmal
For a full account see *Skywatchers*, pp. 283-8. For a different view on the Venus alignment, which is disputed by Aveni, see Sprajc's paper (ch 24) in *Archaeoastronomy in the 1990s*. A paper by Harvey and Victoria Bricker, "Astronomical References in the Throne Inscription of the Palace of the Governor at Uxmal", *Cambridge Archaeological Journal*, 6 (1996), 191-229, shows very well indeed how an integrated, cross-disciplinary approach, involving a reinterpretation of the hieroglyphic "Throne inscription" above the central doorway of the Governor's Palace at at Uxmal (part of which depicts Mayan zodiacal constellations), together with archaeological and archaeoastronomical evidence, really can advance our understanding of the Mayan celestial imagery, encapsulated both in its inscriptions and its architectural alignment. The paper is accompanied by comments from other scholars and a response by the authors.

Photos of Uxmal and the Venus alignment at the Governor's Palace

Teotihuacan and the cross-circles
On the idea that pecked cross-circles might have been used as survey markers at Teotihuacan, see Chiu and Morrison, "Astronomical origin of the offset street grid at Teotihuacan", *Archaeoastronomy* no. 2 (*JHA* 11)(1980), S55-64.

For a critique, see Ruggles and Saunders, "The interpretation of the pecked cross symbols at Teotihuacan..", *Archaeoastronomy*, no, 7 (*JHA* 15)(1984), S101-110. This is followed by a rejoinder by Aveni. For further methodological discussion see Aveni's paper (ch 20) in *Records in Stone*. For the broader context see *Skywatchers*, pp. 222-35.

Photos of Teotihuacan and some of the cross-circles

Lecture 8: Integrating evidence from art and ethnohistory

Objectives

To give an understanding of the context within which American archaeoastronomy developed in the 1980s and beyond. Today's lecture continues the discussion of different ways in which evidence from other sources can be integrated with evidence from the archaeological record, identifying some of the fundamental methodological issues that arise.

There are two cases studies, which introduce evidence from art and ethnohistory. The first concerns sacred geography in the valley of Mexico in Aztec and pre-Aztec times. The second, more extensive, case study concerns continuity of tradition in southern Peru from pre-Inca to Inca and through to modern times.

Further information and supporting materials

Tenochtitlan and sacred geography in the valley of Mexico
On the Templo Mayor, Tenochtitlan see Davíd Carrasco (ed.), *To Change Place: Aztec Ceremonial Landscapes* (University Press of Colorado, 1991). On Aztec and pre-Aztec sacred geography see Johanna Broda's "Astronomical Knowledge, Calendrics, and Sacred Geography in Ancient Mesoamerica", chapter 9 of *Astronomies and Cultures*. See also Stanislaw Iwaniszewski's article "Archaeology and Archaeoastronomy of Mount Tlaloc, Mexico: a Reconsideration", *Latin American Antiquity*, 5(2), 1994, 158—76. John Carlson's ideas relating to Cacaxtla and Xochitecatl, presented at the Oxford 5 conference in summer 1996, are to be published in the conference proceedings, but for his ideas on Venus-regulated warfare and ritual sacrifice in ancient Mesoamerica see chapter 8 of *Astronomies and Cultures*.

Photos of Cacaxtla, Xochitecatl, and La Malinche

Nazca, Cuzco, and the enduring concept of radiality

On the general archaeological background to South America there are several books in the library, such as *Ancient South America* by Karen Olsen Bruhns, Cambridge University Press (Cambridge World Archaeology series), 1994.

The best general source on the issue at hand, and a good read to boot, is Anthony Aveni's *Nasca: Eighth Wonder of the World?* (British Museum Press, 2000). For a briefer introduction see ch. 9 of *Ancient Astronomies*, ed. A.F.Aveni (Smithsonian Institution, Washington, 1993).

For the definitive academic account and most thorough overview on the Nazca lines and their intepretation see *The Lines of Nazca*, ed. A.F.Aveni (American Philosophical Society, Philadelphia 1990), which contains articles from many points of view (archaeological, ethnographic, astronomical/statistical) focussing on the different types of data relevant to the interpretation of the Nazca lines.

Ground markings on the Nazca pampa
Building a line: a modern exercise
On Incaic astronomy see *Astronomy and Empire in the Ancient Andes* by Brian Bauer and David Dearborn (University of Texas Press, 1995). Aveni's *Stairways to the Stars: Skywatching in Three Great Ancient Cultures* (Wiley, 1997) contains a good section on the Cusco *ceques*, but see also *The Sacred Landscape of the Inca* by Brian Bauer (University of Texas Press, 1998).

Modern Cuzco

Aveni mentions *quipu* (or *khipu*) on pp. 308-310 of *Skywatchers*. For the keen, there is lots more about them in Gary Urton's *The Social Life of Numbers* (University of Texas Press, 1997), in the context of an exploration of indigenous concepts of number amongst the Quechua-speaking peoples of South America. In 1996, thirty-two previously undiscovered quipu/khipu were found in association with mummy-bundles in cliff-side caves in north-eastern Peru. One of these appears to be a two-year calendar with additional information given for particular dates. A paper by Gary Urton entitled "A calendrical and demographic tomb text from Northern Peru" (*Latin American Antiquity*, 12(2) (2001), 127-147) conveys the excitement of this discovery, and also refers to other, more general, references on the quipu.

On Misminay, see Gary Urton's *At the Crossroads of the Earth and Sky* (University of Texas Press 1981).

Lecture 9: Astronomy in context: case studies from modern indigenous groups

Objectives

To illustrate, through case studies from modern indigenous groups, the differing nature of astronomies in non-Western cultural contexts and to highlight and question a number of assumptions that are commonly made when studying astronomies in historic or prehistoric contexts.

Further information and supporting materials

The Hopi ceremonial calendar
The precision of the Hopi horizon calendar is referred to extensively, for example in Colin Renfrew's *Before Civilization*. See also Stephen McCluskey, "The astronomy of the Hopi Indians", *Journal for the History of Astronomy* 8 (1977), 174–95; "Space, time and the calendar in the traditional cultures of America", chapter 3 of *Archaeoastronomy in the 1990s*. Steve has also supplied two additional references: "Calendars and Symbolism: Functions of Observation in Hopi Astronomy", *Archaeo-astronomy* (supplement to *Journal for the History of Astronomy*), 15 (1990), S1-S16; and "Historical Archaeoastronomy: The Hopi Example", pp. 31-57 in Anthony F. Aveni (ed.) *Archaeoastronomy in the New World* (Cambridge: Cambridge University Press, 1982). In addition, on the Zuni and their sun-watching stations see Michael Zeilik, "Keeping the sacred and planting calendar: archaeoastronomy in the Pueblo southwest", chapter 10 in *World Archaeoastronomy* (see main reading list).

Mursi time-reckoning
The original paper on this is David Turton and Clive Ruggles, "Agreeing to disagree: the measurement of duration in a southwestern Ethiopian community", *Current Anthropology* 19 (1978), 585–600. For commentary see, e.g., Aveni's *Empires of Time* (see main reading list), pp. 172–4.

The Borana calendar and Namoratunga
For all the relevant references see chapter 11 of *Archaeoastronomy in the 1990s*.

Cosmology and architecture in the US South-west
On the Pawnee see Von Del Chamberlain, *When Stars Came Down to Earth: Cosmology of the Skidi Pawnee Indians of North America*, Ballena Press/Center for Archaeoastronomy, 1982, esp. pp. 155–62 and178–83 on earth lodges. On the Navajo see Trudy Griffin-Pierce, *Earth is my Mother, Sky is my Father: Time and Astronomy in Navajo Sandpainting*, University of New Mexico Press, 1992, esp. pp. 21 and 92–6 on hogans.

For a glimpse of the sheer complexity that may be encountered when we try to understand the ways in which the structure of the cosmos is reflected in a whole variety of aspects of social behaviour, compare the example of the Yucatec Maya village of Yalcobá (John R. Sosa, "Cosmological, symbolic and cultural complexity among the contemporary Maya of Yucatan", pp. 130–42 of *World Archaeoastronomy* (see main reading list).

Seminar session 2

Aims of the session
The main aim, as with the first session, is to have a broad-based discussion focussing on issues of interpretation and explanation. The central question is: how best do we go about formulating sensible theories about the social context of astronomy in various social contexts around the world? The three groups of people will lead the discussion with short presentations in a format of their choosing, but there will be plenty of time for a debate to lead on from there. I hope to be feeding in and clarifying issues, but primarily I want to get you all thinking, so the floor is yours rather than mine and I aim to be doing as little talking as possible!

Groups and topics

Groups and topics for this session are as follows:

Group 1: Nick, Vicky, Sadie Astronomy and conceptions of space and time

Group 2: Anna-Louise, Tom, Katie, Joanna Astronomy and calendrical development

Group 3: Hannah, Jonathan, Daniel Astronomy and sacred landscapes

Words of advice
All the topics are broad and thematic, and you could tackle them in a number of ways in order to raise key issues. Chapter 9 from *Astronomy in Prehistoric Britain and Ireland* should provide an adequate starting point for further reading in each case, and chapter 1 of *Astronomies and Cultures* should also be helpful. The following are some initial suggestions for suitable case studies, mainly from the Oxford 3 books (note the overlaps):
Stephen McCluskey, "Space, time and the calendar in the traditional cultures of America", chapter 3 in *Archaeoastronomy in the 1990s*

- Joanna Broda, "Astronomical knowledge, calendrics and sacred geography in ancient Mesoamerica", chapter 9 in *Astronomies and Cultures*

- David Turton and Clive Ruggles, "Agreeing to disagree: the measurement of duration in a southwestern Ethiopian community", *Current Anthropology*, 19 (1978), 585–600.
  Stephen McCluskey, *Astronomies and Cultures in Early Medieval Europe*, Cambridge University Press, 1998 (see also chapter 4 in *Astronomies and Cultures*)

- Joanna Broda, "Astronomical knowledge, calendrics and sacred geography in ancient Mesoamerica", chapter 9 in *Astronomies and Cultures*
  Malville and Fritz, "Cosmos and Kings at Vijayanagara", chapter 6 in *Astronomies and Cultures*
  Brian Bauer and David Dearborn, *Astronomy and Empire in the Ancient Andes*, University of Texas Press, 1995

Then, as a final treat, Matt Parker will be doing a ten-minute presentation on positional astronomy -- the perfect revision aid for those who feel a little rusty about the basic astronomical concepts!

Essay title and information

The four essay titles are:

1. A good deal of work in archaeoastronomy concentrates on astronomical alignments in architecture. To what extent does the broader archaeological and historical evidence support this prepossession?

2. In what different ways can the celestial cycles affect the timing of human activities and how this can be reflected in the material record?

3. How does the general appearance of the sky differ between polar, temperate, and tropical latitudes? In what ways can the general appearance of the sky influence the development and nature of creation myths, calendars and cosmologies?

4. "Hierophanies" involving interplays of shadow and light at sacred places sometimes produce special effects visible on only very rare occasions. They have aroused the interest of archaeoastronomers for decades and have often created enormous public interest, forming an essential part of the "popular" image of archaeoastronomy. What can they tell the archaeologist?

The word limit is 3000 words and the deadline for submission of the essay is Tuesday May 6 (by 5.00 p.m.).

Each question covers a very broad topic and could be elaborated upon in many different ways. Whichever question you choose, you will be expected to invoke a

wide range of case studies from different chronological periods and geographical areas, *avoiding* those that have been covered in some detail in lectures.

In the first seminar session we concentrated on some case studies that have appeared recently in the mainstream archaeological literature. In your background research for the essays you will need to look particularly at the archaeoastronomy literature. In addition to the two journals

1. *Archaeoastronomy: The Journal of Astronomy in Culture*, published by the University of Texas Press, and

2. the *Archaeoastronomy* supplement to the *Journal for the History of Astronomy*, published by Science History Publications in the UK,

both of which are available in the library, there are several volumes of conference proceedings that provide a good range of source material, including those listed amongst the core texts. Some of the most useful ones are:

- *Astronomies and cultures*, edited by Clive Ruggles and Nicholas Saunders (University Press of Colorado, 1993) and *Archaeoastronomy in the 1990s*, edited by Clive Ruggles (Group D, 1993). These two volumes form the proceedings of the 3rd "Oxford" international symposium on archaeoastronomy held in St Andrews, Scotland, in 1990.

- *World Archaeoastronomy*, edited by Anthony Aveni (Cambridge University Press 1999), the proceedings of the 2nd "Oxford" international symposium on archaeoastronomy, held in Mérida, Mexico, in 1986.

- *Astronomy, Cosmology and Landscape*, edited by Clive Ruggles, Frank Prendergast and Tom Ray (Ocarina Books, 2001), the proceedings of the 1998 SEAC (European archaeoastronomy) conference held in Dublin, Ireland.

- *Astronomy and cultural diversity : proceedings of the International Conference "Oxford VI & SEAC 99"*, edited by César Esteban and Juan Antonio Belmonte (Organismo Autónomo de Museos del Cabildo de Tenerife, 2000). This is the proceedings of the 6th "Oxford" international symposium on archaeoastronomy, jointly with the SEAC99 (European archaeoastronomy) meeting, held in La Laguna, Tenerife, in 1999.

- *Астрономия Древний Обшесть (Astronomy of Ancient Societies)*, edited by T.M. Potyomkina and V.N. Obridko (Nauka, 2002), the proceedings of the SEAC 2000 conference held in Moscow. Papers are either in Russian with extended abstracts in English, or vice versa.

- *Actes de la Vème Conférence Annuelle de la SEAC*, edited by Arnold Lebeuf, Marius S. Ziolkowski and Arkadiusz Soltysiak (University of Warsaw, 1997), the proceedings of the 1997 SEAC (European archaeoastronomy) conference held in Warsaw, Poland.

- *Actas del IV Congreso de la SEAC "Astronomia en la cultura"*, edited by Carlos Jaschek and Fernando Atrio (University of Salamanca, 1997), the proceedings of the 1996 SEAC (European archaeoastronomy) conference held in Salamanca, Spain.

- *Ancient times, modern methods : proceedings of the third Annual General Meeting of the European Society for Astronomy in Culture (SEAC), Sibiu, 31 August-2 September 1995*, edited by Florin Stanescu (Lucian Blaga University, Sibiu, 1999), the proceedings of the 1995 SEAC (European archaeoastronomy) conference held in Sibiu, Romania.

- *Proceedings of the second SEAC Conference, Bochum, 29-31 August 1994*, edited by Wolfhard Schlosser (Ruhr-Universität, 1996), the proceedings of the 1994 SEAC (European archaeoastronomy) conference held in Bochum, Germany.

- *Astronomical traditions in past cultures: proceedings of the first Annual General Meeting of the European Society for Astronomy in Culture (SEAC), Smolyan, Bulgaria, 31 August-2 September 1993*, edited by Vesselina Koleva and Dimiter Kolev (Bulgarian Academy of Sciences, 1996), the proceedings of the 1993 SEAC (European archaeoastronomy) conference held in Smolyan, Bulgaria.

All of these are available in the library.

Reading List

This page lists the main core texts for the course. Many other books and papers are listed elsewhere in the on-line resources for this course, which will be linked in as the course progresses, but I cannot guarantee that these will all be in the library or bookshop.

Essential reading

Astronomy in Prehistoric Britain and Ireland, by Clive Ruggles (Yale University Press, 1999). This is the core text for the first part of the course.

Skywatchers, by Anthony F. Aveni (University of Texas Press, 2001). This long-awaited update to Aveni's *Skywatchers of Ancient Mexico*, which was published in 1980, is a comprehensive and up-to-date survey of Mesoamerican archaeoastronomy that provides an essential background to the second part of the course.

Tombs, Temples and their Orientations: A New Perspective on Mediterranean Prehistory, by Michael Hoskin (Ocarina/Oxbow Books, 2001). This synthesis of Hoskin's fieldwork over many years in southern Europe epitomizes the new direction taken by European archaeoastronomy in recent years.

Astronomies and Cultures, edited by Clive Ruggles and Nicholas Saunders (University Press of Colorado, 1993) and *Archaeoastronomy in the 1990s*, edited by Clive Ruggles (Group D Publications, 1993).

These two volumes arising from the third 'Oxford' International Conference on Archaeoastronomy, held in St. Andrews in 1990, contain a variety of papers that are still widely cited. A&Cs contains ten longer overviews papers while AA90s contains 31 shorter research reports. Together, the various contributions cover theory, method and practice and give an excellent insight into the scope of work in archaeoastronomy as well as some of the main issues of contention.

Highly desirable

Each of the following three volumes, arising from major archaeoastronomy conferences, contains a selection of papers demonstrating a variety of study areas and approaches within the subject.

Astronomy, Cosmology, and Landscape, edited by Clive Ruggles, Frank Prendergast and Tom Ray (Ocarina Books, 2001). SEAC is the leading organisation for European archaeoastronomy, and this is the proceedings of the SEAC98 meeting held in Dublin.

Astronomy and Cultural Diversity, edited by Juan Belmonte and César Esteban (Organismo de Museos del Cabildo de Tenerife, La Laguna, Tenerife, 2000). The SEAC99 (European) meeting was combined with the triennial 'Oxford' International conference and this is one of two volumes of papers arising from this joint meeting. The remaining, keynote papers have been published in volume 15 of *Archaeoastronomy: The Journal of Astronomy in Culture* (2001).

World Archaeoastronomy, edited by Anthony F. Aveni (Cambridge University Press, 1989). The Proceedings of the Second 'Oxford' International Conference on Archaeoastronomy, held in Mérida (Mexico) in 1986. The best compendium of research in archaeoastronomy in the mid-1980s.

See also

Stairways to the Stars, by Anthony F. Aveni (Wiley, 1997). Based around three case studies -- "megalithic astronomy" in prehistoric Britain, the ancient Maya, and the Inca empire -- this book is aimed at the non-specialist and provides a highly readable introduction to the principles and scope of archaeastronomy. However, for more up-to-date and detailed material in the first two areas see *Astronomy in Prehistoric Britain and Ireland* and *Skywatchers* respectively (for details see above). And for a different perspective on Incaic archaeoastronomy see *Astronomy and Empire in the Ancient Andes* (for details see below).

Conversing with the Planets, by Anthony F. Aveni (Times Books, 1992) and *Empires of Time*, by Anthony F. Aveni (Basic Books, 1992). Two excellent books discussing the social context of astronomy. Second editions of both have recently appeared, published by the University Press of Colorado.

Astronomy and Empire in the Ancient Andes, by Brian S. Bauer and David S.P. Dearborn (University of Texas Press, 1995). An examination of the place of ancient astronomy in the Inca world.

Astronomies and Cultures in Early Medieval Europe, by Stephen C. McCluskey (Cambridge University Press, 1998). This new book covers the development of astronomies in Europe from Celtic Gaul through to late Medieval times. It is important in addressing questions that normally fall outside the remit of history of astronomy and until now have been largely ignored by archaeoastronomers.

The Oxford Encyclopedia of Mesoamerican Cultures (in 3 volumes), edited by Davíd Carrasco (Oxford University Press, 2001), which is available in the reference section of the library, contains several useful articles on, or relevant to, Mesoamerican archaeoastronomy. The entries on "Astronomy" and "Festivals and festival cycles" make good starting points: then use the "see also" lists to roam more widely.

Archaeology of Ancient Mexico and Central America: An Encyclopedia, edited by Susan T. Evans and David L. Webster (Garland, 2001), next to the above on the reference shelves, also contains a number of relevant entries. Start at the entry on "Astronomy, archaeoastronomy, and astrology" or look up "Astronomy" in the index. *Astronomy across Cultures*, edited by Helaine Selin (Kluwer, Dordrecht, 2000). This is a very useful compendium of preliterate astronomical traditions amongst human societies in places as diverse as central and southern Africa, the Islamic world, south-east Asia, aboriginal Australia, and ancient Polynesia. However, it is shockingly expensive and only a single copy is likely to be available in the library.

Astronomy before the Telescope, edited by Christopher Walker (British Museum Press, 1996). This book mainly concerns topics within the history of astronomy, but the chapters on archaeoastronomy in Europe, astronomy in the Americas, and indigenous astronomy in Africa, Australia and Polynesia are all relevant.

Useful journals

The two main journals in archaeoastronomy are *Archaeoastronomy: The Journal of Astronomy in Culture*, published by the University of Texas Press, Austin, and the *Archaeoastronomy* supplement to the *Journal for the History of Astronomy*, published in Cambridge. Both are available to students and staff in the University of Leicester's library.

URL's

http://www.le.ac.uk/has/cr/oldrug/aa/index.html

http://www.le.ac.uk/has/cr/oldrug/aa/faq.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/timetable.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/lectures.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/lec1.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/lec2.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/lec3.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/lec4n5.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/sem1.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/lec6.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/lec7.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/lec8.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/lec9.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/sem2.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/essay.html

http://www.le.ac.uk/has/cr/oldrug/aa/a3015/booklist.html

http://www.le.ac.uk/has/cr/oldrug/image_collection/

http://www.le.ac.uk/has/cr/oldrug/aa/progs/index.html

http://www.le.ac.uk/has/cr/oldrug/aa/progs/HorizonFinder.html

http://www.le.ac.uk/has/cr/oldrug/aa/progs/pohualli.html

http://www.le.ac.uk/has/cr/oldrug/aa/progs/decpak.html

http://www.le.ac.uk/has/cr/oldrug/aa/progs/pberrs.html

http://www.le.ac.uk/has/cr/oldrug/aa/progs/stimes.html

http://www.le.ac.uk/has/cr/oldrug/aa/progs/getdec.html

http://www.le.ac.uk/has/cr/oldrug/aa/progs/oddsnends.html

http://www.le.ac.uk/has/cr/oldrug/aa/resources/links.html (not all linking correctly)

Errors/anomalies in links(as of 20 May 2012):

Lecture 1:
1) Link to "Records In Stones"

2) Link to Euan MacKie's response to "Cosmology, calendars, and society in Neolithic Orkney: a rejoinder to Euan MacKie", by Clive Ruggles and Gordon Barclay, *Antiquity* 74 (2000), 62-74

Lecture 2:
1) Link to "Records In Stones"

Lecture 3:
1) Richard Bradley's recent excavations at Tomnaverie: first link redirects to http://www.reading.ac.uk/archaeology/, second link broken.

Lectures 4 and 5:
1) Photograph of the "Slaughter Stone" and Heelstone at Stonehenge Copyright © Graeme Barker, redirects to http://www2.le.ac.uk/departments/archaeology/

Lecture 6:
1) A general web page on archaeoastronomy featuring a commentary on the Abri Blanchard bone: Link is broken

Lecture 7:
All work

Lecture 8:
All work

Reading List:
1) *Astronomy, Cosmology, and Landscape*, edited by Clive Ruggles, Frank Prendergast and Tom Ray (Ocarina Books, 2001). - redirects to Oxbow Books.

2) *Astronomy before the Telescope*, edited by Christopher Walker (British Museum Press, 1996). - redirects to Oxbow Books

Related Links Page:
1) *David Dearborn* - not available

2) *The Archaeology Network* - not available