

the natives of these parts, these features could hardly have been designed for human beings. The Maya, apparently, said they were for a diminutive people they called the “Alux”—but who were they? There are indeed revelations in *Ancient Structures* for even the informed reader, and what must appear as a mind-boggling array of them to the more general reader.

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Reviewer's Preface to the Following Three Reviews

In the late Neolithic and the early Bronze Age of northwestern Europe—roughly from 4500 BC to 1500 BC—tools were fashioned from stone and bone. The merest traces only of primitive dwellings have been found—circular shapes discovered in aerial photographs, remnants of post-holes identified in archaeological digs, a few subterranean constructions lined with stone. People are thought to have subsisted in scattered, family-size groups. There was no written language: these were prehistoric times.

Yet—a startling apparent anomaly—those cultures also planned and built massive, elaborate structures, often incorporating huge blocks and slabs of stone (“megalithic”) that needed the efforts of hundreds of workers over periods of years.

Various explanations for these anomalous constructions have been ventured over the centuries. In the 1960s and 1970s, such astronomers as Gerald Hawkins and Fred Hoyle claimed that very precise astronomical knowledge was incorporated into the design of Stonehenge and similar sites. But the experts did not arrive at any overarching consensus. Below, there are reviews of three fairly recent books which summarize the current state of knowledge about these things from informed, levelheaded but not hidebound perspectives. Aubrey Burl's survey of stone circles has a wealth of detailed information, and interpretations arrived at over decades by one of the leading scholars in the field. Clive Ruggles addresses archaeoastronomy, giving an overview of what interested observers as well as modern researchers should understand about archaeological and astronomical aspects of megalithic sites and about statistical approaches to interpreting the significance of these sites. Richard Bradley introduces a recently developed approach that focuses on natural features of the landscape as much, or even more, than on the monuments built on sites that were presumably chosen because of their inherent suitability for the planned construction—suitability not so much of an engineering sort as of a cult or religious or spiritual sort.

An Archaeology of Natural Places by Richard Bradley. New York: Routledge, 2000. xii + 177 pp., \$24.99, paper. ISBN 0-415-22150-1.

This book describes a new approach added during the last decade or two to the traditional tools of archaeology: Instead of studying specifically and only the remains of settlements, monuments, and burial structures, increasingly attention is being paid to the significance of natural features of the landscape.

Of course this new attitude was no sudden invention, as Bradley illustrates from personal experience:

In one sense this book caught me by surprise. It reflects on the results of research carried out over more than fifteen years, but locates them in a framework of which I have only recently become fully aware. (p. xi)

Bradley discusses such diverse areas as northern Scandinavia and the eastern Mediterranean. In the former, natural places continue to be used as sacred sites by the Saami. In the latter, it is known that caves and other natural features were so used in Crete and ancient Greece.

Evidence comes in three salient types:

1. Votive deposits, offerings, are found in a variety of places. Analysis seeks to understand why those places were chosen; what their relation may be to other special sites; what the significance is of the particular materials deposited; and how those things changed over time.
2. Rock art, analyzed along similar lines (with analysis of the representations taking the place of analysis of particular materials).
3. Production sites, in the main places where stone tools were fashioned or from which material for tools or for monuments was taken.

The new approach concentrates on asking, “Why here and not there?”; “What special features does this landscape have to make it particularly desirable for this purpose?” The contrast with the older approach, which focused on technical aspects, is illustrated by the interpretation of axe trading. It has long been known that stone axes were traded over long distances, for example from Ireland to northeast Scotland. Traditionally this was taken to indicate that the Irish stone must have had particularly useful characteristics. But it turns out that sometimes this is not the case; that production sites were often in remote places with difficult access even when equally suitable material was more readily available elsewhere; and furthermore, some non-functional features were deliberately left on axes apparently to characterize their place of origin. These items were prized not only for their utility but for where they came from. Such special, foreign materials are often found in votive deposits or associated with burials. Though Bradley does not emphasize it, here is one illustration of how modern those people were: We have the same tendencies, after all, in prizing especially certain foreign-made items like Italian apparel or automobiles, or T-shirts and baseball caps bearing certain brand

names—features of those items that have purely notional and not any functional significance. In Japan in the 1970s, I was struck that old American hubcaps and license plates were highly desired items that fetched good prices.

Mountains, caves, springs, rivers, and seas have often been imagined to have transcendent properties. Mountain tops have been the abodes of gods; rivers have been boundaries between the mundane world and the underworld of the dead. Some cultures remained satisfied to use available natural features in this way, for instance the Saami who follow migrating reindeer herds; other cultures—perhaps, and rather naturally, those that adopted a settled lifestyle—began to create buildings for ritual purposes. Using as one example certain caves in Crete where structures were built on sites already used as sacred, Bradley poses intriguing questions:

“What do monuments do to the places where they were built?” They might give structure to how the sacred place can be accessed; access could be restricted; perhaps distinctions could be made between participants in rituals and spectators.

“Were natural rock outcrops of unusual shape once seen as constructions by the gods or by ancestors? Is that why some places were chosen as sacred ones?” And, conversely, “Would long-disused monuments necessarily be recognised as human constructions, or would they have acquired a significance similar to that of natural places?” (p. 156)

“Was rock art sometimes used to model the surrounding landscape?”

Traditionally, archaeology has tried to understand prehistoric monuments by examining them intensively and looking into what their function might have been. The new approach was in a sense anticipated in archaeoastronomy, noting features of the surrounding landscape that might have served to indicate the direction from a monument toward some special astronomical event; but in its full-fledged form, the archaeology of natural landscapes suggests that in order to understand monuments, one must look *away* from them as much as at them, one must look around them and also *before* them, at what significance the site might have had before anything was built there.

What Bradley calls archaeology of natural places really amounts to an archaeology of human consciousness. The settings in which human activities took place—in addition of course to the material remains of those activities—offer insights into the significance human beings attached to the specifics of their environment. The book’s interest for non-specialists is more in the fascinating questions raised than in particular answers already available, for those are groping and speculative—inevitably so in this nascent stage of these studies—and they are couched in language that may be more readily digested by social scientists than by generalists, for example the quote from Tilley on p. 153: “An already encultured landscape becomes refashioned, its meanings now controlled by the imposition of the cultural form of the constructed monument.”

Nevertheless, the book gave this non-specialist reader a radically changed view of what archaeology can do, as well as deepened respect for the painstaking,

detailed, effort-intensive collecting of data that must precede analysis and interpretation. Here is Bradley's concluding remark:

Perhaps it is because natural places lost some of their power in the historical period that they have lost so much of their prehistory as well. It has been the aim of this book to establish how much of it can still be recovered. (p. 161)

Astronomy in Prehistoric Britain and Ireland by Clive Ruggles. New Haven, Connecticut: Yale University Press, 1999. xi + 286 pp., \$70, cloth. ISBN 0-300-07814-5.

Archaeoastronomy is an interdisciplinary field that was given this name less than four decades ago. Unorganized attempts to understand astronomical knowledge and practice in prehistory began much longer ago, of course. In the 19th century there was speculation about the astronomical significance of features of the Egyptian pyramids. The notion that Stonehenge was a temple to the sun, oriented to midsummer sunrise, can be traced back for centuries. Up to the present, though, popular views and specialist views differ considerably about what pre-literate peoples knew or thought about sun, moon, planets, and stars; and among the specialists, astronomers and archaeologists have disagreed more than they have agreed.

Clive Ruggles has been since 1999 Professor of Archaeoastronomy at the University of Leicester, and he may well be still the only person in the world to hold a chair in that field. Earlier he had worked in astrophysics, archaeology, statistics, computing, and geographical information systems (GIS); and he has done extensive field work. This book is a conscious attempt to indicate what anyone working in archaeoastronomy should know about archaeology, astronomy, and statistical inference, and about the value of a self-conscious and informed research methodology. The book is intended to be accessible to the general reader, and is largely successful in that, if one follows the invitation to ignore (most of) the "boxes" that go into detail about various aspects of astronomy, archaeology and statistics, and if one ignores (almost all of) the many endnotes—at least in a first reading. For specialist readers, the bibliography is comprehensive and there are detailed lists of sites and relevant data. The book is essential reading for anyone interested in megalithic astronomy and megalithic culture and has many worthwhile insights about interdisciplinary research, many of which are pertinent to such anomalistic fields as parapsychology.

Part I of the book considers the controversies of the 1960s and 1970s about precise astronomical alignments claimed to be present in such structures as Stonehenge, as alleged by, among others, the engineer Alexander Thom and the astronomers Gerald Hawkins and Fred Hoyle. Ruggles reviews the underlying data, and then subjects them to the test of results from an independent statistical study of possible alignments at 300 sites in western Scotland. The discussion is didactic or pedagogic in the best sense of those words, instruct-

ing through specific and detailed examples about such things as selection bias and its consequences. At the same time as Ruggles explains the need to establish a precise protocol *before* embarking on field work, however, he is also clear about the need to change one's view as a result of experience. At several points throughout the book, he returns to this dilemma: on the one hand, the reliability of statistical inference hinges on making tests independent of the hypothesis to be tested; on the other hand, one needs to be able to learn previously unexpected things from the field work carried out for the testing. Ruggles suggests that a resolution of the dilemma is available by adopting a Bayesian instead of a frequentist statistical approach. He also acknowledges that statistical evaluation can only reveal some lowest common denominator of apparently similar sites, moreover averaged over the several millennia of time during which megalithic sites were in use; it remains possible that a few places may represent something special, not only in cultural significance but also in precision or depth of astronomical knowledge.

The general points adduced in these discussions should be attended to not only in archaeoastronomy but also in ufology, cryptozoology, and parapsychology. How, for example, does one decide what is relevant and what not? Significant astronomical alignments have been suggested in rows of stones; pairs of stones; across various pairs of stones that form rings; from rings to outliers; between artificially erected structures and such features of the natural landscape as peaks or valleys; along the sides of flat slabs; along the passages of burial chambers . . . One needs to think carefully about reasons for including or excluding examples among the many possibilities.

Careful thought raises intriguing questions. Why were certain apparently available alternative sites *not* chosen? Could the deliberate *exclusion* of certain views have been as important as drawing attention to obviously indicated views? Why was it important laboriously to erect structures of massive stone, when enclosures and alignments could much more easily have been built of wood? Since boating was evidently pervasive from at least 6000 BC, around the British Isles and across the Channel to Europe, surely Neolithic and even Mesolithic peoples must have had a good understanding of the tides, which are notoriously treacherous in a number of places around Britain; was there then a recognition of the correlation between tides and phases of the moon? Ruggles consistently emphasizes that the proper aim of archaeoastronomy, as of archaeology, is to understand what megalithic sites signified for the people who used them. The renowned passage-tomb of Maes Howe, and the stone rings of Brodgar and Stenness, all dating from around 3000 BC, took an effort of some 100,000 person-hours to build; Avebury, Stonehenge, and Silbury Hill required millions of person-hours. How and why was all this organized?

An instructive example about the difference between a purely "scientific" approach and a more comprehensive one concerns possible alignments that might have the significance of indicating full moon at midwinter or at mid-

summer (p. 149). From an “objective” viewpoint, precise indication of either the northern (midwinter) or the southern (midsummer) limit would be an equally remarkable sign of advanced “scientific” astronomic knowledge. But the midwinter full moon, which provides useful illumination during long and otherwise dark nights, would likely have held more meaning to those prehistoric people than would the full moon during short summer nights that in any case never become wholly dark.

Without going unnecessarily into abstract philosophical discussion, Ruggles acknowledges the inevitable tension between the need for objectively grounded, scientific, astronomical study of megalithic structures and, on the other hand, the need to recognize that what seems significant to us may not have seemed significant to our forebears, in particular the very separation between objective and subjective, between science and symbolism. Whatever astronomical alignments may have been incorporated in the megalithic structures that seem to us so impressive may perhaps reflect alignments used also in everyday life and everyday dwellings; studies of these monuments should not be separate from study of all aspects of the cultures in which they were set up. Though many sites appear to have been in use for 3 millennia or even more, their function and significance may—is most likely to—have changed drastically over that period. Even when alignments seem to have obvious astronomic significance, perhaps they were influenced as much by other considerations, such as orientation in relation to ancestral graves or to significant aspects of the landscape.

Much of this book aims to counteract dogmatic claims about precision “scientific” prehistoric astronomy, but it also accepts that there was evidently a *general* recognition of heavenly facts. The recumbent stone circles of northeast Scotland and the short stone rows of southwest Ireland strongly indicate orientation to significant points of the moon’s path. Yet the stone rows of western Scotland have no clearly lunar significance; and Newgrange in Ireland and Maes Howe on Orkney have alignments that are striking at the times of solar solstice. Was there a general shift in Neolithic times from the moon to the sun as the heavenly body of prime significance? Or are the differences owing to regional or cultural factors rather than to time?

Ruggles speaks plainly. He criticizes writing by “a prominent historian of science in which earthen long barrows, cursuses, earth-cut figures and white horses, avenues, henges, stone circles, and of course Stonehenge itself, all receive a stellar, solar or lunar interpretation On the other hand, archaeologists who sweepingly criticise archaeoastronomy sometimes seem to show a bewildering ignorance of the archaeoastronomical literature since 1980 . . . , as in fact do others who tentatively accept some of its earlier conclusions Yet others make statements that are unjustified, . . . simply wrong, . . . or even nonsensical” (p. 144). But there is nothing *ad hominem* here; the criticisms are directed to substance, and Ruggles pays overt respect to the initiatives and efforts and ideas of such people as Aubrey Burl and the Thoms

even as he points to the inadequacies of conclusions reached. The message of this book could perhaps be summed up by the suggestion (p. 257, note 103) that the field of study be described as “archaeocosmology” rather than archaeoastronomy. Ruggles’ summary of the history of the subject (p. 162) is likely to resonate with investigators of such other subjects as parapsychology:

Remarkably, perhaps, we seem to have come full circle, from criticising the inherent biases in the work of Thom and others, through seeking rigour and objectivity, to recognising the shortfalls of that approach and discovering the need to readmit subjectivity as part of a controlled approach which involves a ‘continuous dialectic between ideas and empirical data’ How the exploration loop is controlled is obviously critical, lest we simply fall once again into all the traps identified towards the beginning of this book The Bayesian approach promises to reintroduce a quantitative element appropriate, and necessary, to this process.

Perhaps the most important lessons to be learned overall are that (except on the most basic level) different interpretations are always possible, even given the same empirical data, and that personal convictions should never go beyond statements such as ‘it seems possible that’, ‘it seems very likely that’, and ‘the evidence clearly seems to indicate that’ (although Bayesians would be prepared to put probability values on such statements). While it may sound more enticing to say, with absolute conviction, that people in prehistory did this, or thought that, or that the purpose and meaning of particular monuments was this—and this is something of which archaeoastronomers and archaeologists alike have been guilty over the years—it is ultimately misleading, and should immediately raise our suspicions Better, and more rewarding by far, is to seek to assess existing ideas against new empirical evidence, and to seek to raise interesting and exciting new possibilities. Through these twin goals we can hope to inch towards genuinely better understandings of the past in our own terms, whether personal or shared with others of similar background, rather than arriving with misplaced confidence at completely indefensible conclusions.

The Stone Circles of Britain, Ireland and Brittany by Aubrey Burl. New Haven, Connecticut: Yale University Press, 2000. xviii + 462 pp., \$60, cloth. ISBN 0-300-08347-5.

In some respects, Stonehenge is for the Sassenachs¹ what the Loch Ness Monster is for the Scots. Both are internationally famous. Both are commonly but mistakenly thought to be unique. Tall and fanciful tales have been spun about both subjects. The mysteries surrounding both are better known—and easier to grasp—than the fragmentary bits of more reliable but ambiguously interpretable knowledge.

That serious investigators have slowly and laboriously gleaned useful understanding over the decades, about both the Loch Ness Monster and about Stonehenge, is little publicized in the popular media. Among the leading scholars concerned with Stonehenge, and more broadly with the megalithic² culture of Europe, is Aubrey Burl. This book on the stone circles of north-western Europe reflects views arrived at in a lifetime of devoted work and thought (it is also a revision and expansion of a book published in 1976³).

One enormous difficulty for archaeologists is the lack of direct methods for determining the dates of megalithic monuments. Bones and ashes, which can be “carbon-dated”⁴, are not often found at stone circles, whose date must therefore be inferred from other remains found nearby and from similarities of style with other monuments. Both types of inference are fallible, not least because dwelling and monument sites may each have been used over long periods. Even where carbon-datable material is found associated with megalithic stones, it cannot be presumed automatically that construction of the monument was contemporary with deposition of the organic material; indeed, in a number of cases it seems that cremations were deposited after the type of use of the monuments had changed radically, or even after the monuments had fallen into disuse.

Megalithic tombs in Brittany and the corresponding long barrows⁵ in Britain date back to about 4000 BC, about contemporaneous with early Mesopotamian sites. Within a few centuries of that date, stone circles began to be built, and they continued in use for roughly three millennia, spanning from the Neolithic over the Bronze Age to the dawn of the Iron Age; but that is not to say that the function and style of the circles remained unchanged. Burl speculates that circles may have developed from burial chambers (which are also called cairns): The design of long barrows featured increasingly elaborate entrances; fore-courts became more prominent, curved arms from the barrow reached out around part of the fore-courts, kerb-stones on the barrow side of the court were later matched by standing stones around the rest of the court, and eventually free-standing circles replaced the court. In some places, circles remained associated with cairns not only through proximity but also through rows of stones leading from one to the other.

Burl identifies regional or cultural variations. “Circles” are sometimes ellipses or even less regular shapes. They may (albeit quite infrequently) have central features: standing stones, “coves” or open chambers of usually three slabs, very occasionally cists or burials. The heights of the stones are sometimes graded toward one side. Sometimes the stones are paired in size or in shape; as also in double rows or “avenues” of stones, it is generally thought that squat slabs paired with angular ones represented female and male. The wide sides of the stones lie generally, but not always, along the circumference of the circle. Sometimes there are concentric circles. Sometimes there are grouped rings. The numbers of stones around the circumference of a circle vary widely, but there seem to be regional styles, from several dozen to as few as four stones in the “Four-Posters”. One notable northeast-Scottish type of circle (“recumbent”) features one stone lying on the ground, associated with actual or symbolic burials and frequently oriented in a direction that has lunar significance.

Burl suggests an “X-factor” to describe the distribution and cultural affinities of megalithic monuments. One arm of the tilted “X” stretches from Ireland in the SW to NE Scotland; the other, more directly north to south, in

a band from the Orkneys to Land's End. Moreover, in England, the western part of the latter arm comprised largely works in stone, corresponding to the rocky and more elevated terrain, whereas the eastern part of the band, on arable and wooded soils, comprised chiefly earthworks and wooden buildings. The enormous sites of Avebury and Stonehenge, lying toward the center of the band, have not only the obvious stones but also the ditches and banks characteristic of earthwork henges, and excavation has revealed earlier wooden structures that were later superseded by stone.

Drawing on encyclopedic and well-digested knowledge, Burl sketches a megalithic society marked from its earliest days by travel and trading, not only up and down and across Britain but also around its shores and across the British Channel and the Irish Sea. Stone axes seem to have been prized items of trade that were used for symbolic as well as practical purposes; identification of the type of stone shows that, for example, made-in-Ireland axes found their way to northeastern Scotland. From about 2400 BC on, copper mined in southwest Ireland was being traded to France, southern England, and northern Scotland. Some standing stones seem to have served as signposts for sailors and traders. Series of such signposts mark routes across the Welsh mountains.

What were the circles for? Primarily, Burl suggests, they were meeting places, their size corresponding to that of the community served. There are some 1300 identified stone circles in northwestern Europe, many of them so small as to have been used, presumably, by individual families, while others are large enough to have accommodated hundreds of people. Some symbolic, religious or cult association with the phenomenon of death or the possibility of an after-life is indicated by the association of circles with burial mounds. More speculatively but still plausibly, there was also (or therefore) association with the rising or setting of the sun or the moon. Few if any archaeologists now question that circles and cairns were deliberately oriented, typically if not invariably, in directions somehow connected to solar or lunar rising or setting or observation. But Burl does not favor the view that really precise astronomy was practiced and incorporated into circle designs, nor does he endorse Thom's view that the dimensions of circles reveal a standard measure of length⁶ used throughout megalithic Europe. Burl does believe that astronomical orientations served a calendrical purpose, and that there were likely festivals in Neolithic times corresponding to the Celtic seasonal festivals, in particular Beltane in early May to mark the beginning of summer (our May Day) and Samais in early November to mark the beginning of winter (our Halloween).

Meeting places surely, but to what end were the meetings? If they developed indeed from what took place in the fore-courts of cairns, then presumably the meetings were originally for funerals and associated rituals. Perhaps circles are then comparable to churches, and their variations in size analogous to those of churches, which range from private chapels through buildings serving localities and districts to large cathedrals serving wide areas. In

medieval times, churches also served as general-purpose community centers, and perhaps these stone circles did too, at least at some times. Burl points out that caches of the products of various stone-axe “factories” have been found at or close to some circles, and he speculates that these sites may have served as trading posts as well as ritual sites. Moreover, in regions that were crossroads for travelers⁷, Burl identifies mixed styles of circle-design, as though sailors from Ireland and native Scots and others, meeting in these places, presumably primarily for trading, each constructed their own “home-style” enclosures⁸.

Large circles and other megalithic monuments must have served a large population, if only because of the amount of labor needed for constructing them. Thus Burl estimates (p. 328) that raising Silbury Hill may have occupied 500 people working every autumn for 50 years, or 15 years even if they worked the year around and were fed and supported by others. The ditch alone at Avebury would have needed 4 years to complete if 750 people worked at it each autumn after harvest-time (p. 324).

Stonehenge is the subject of the last chapter of the book. As indicated at the beginning of this review, Burl emphasizes that Stonehenge is far from unique in its purpose or function. The several horseshoe-shaped arrangements of stones that were present at various stages, and carvings on some of the stones, bespeak Breton influence; in fact Burl calls Stonehenge a “hybrid” because of the variety of influences apparent in its various phases and details. To be sure, *some* aspects of *one phase* of its construction are unique: the careful and elaborate fashioning of curves, and of lintels held in place by cupped holes fitting over pegs on the uprights. Burl suggests, intriguingly, that people used to working in wood here turned their energies to construction in stone. This phase was probably around 2400 BC, several centuries later than other features, such as the bank and ditch and the “Aubrey holes” around the circumference. Some have speculated that the 56 Aubrey holes indicate calendrical use, corresponding to the years in three cycles of the moon⁹; but Burl notes that similar holes with similar deposits, albeit of varying number, have been found at several other sites. At several places in the book, Burl makes the sensible points that the present state of the monuments does not allow precise measurement of whatever alignments may originally have been intended; that quite approximate lunar or solar orientations would have served well enough for ritual or calendrical purposes; and that, moreover, the actual monuments undoubtedly reflect not only the builders’ intentions but also mistakes and misunderstandings that they undoubtedly suffered.

This book is not a quick read. Every page is dense with details about individual sites, their possible cultural and regional associations, and often something about the climate, flora, and fauna during the relevant historical epoch. Thus the book will serve most people as a work of reference rather than a readable summary. As a reference, it should be indispensable: there is a useful, concise, comparative chronology; an extensive gazetteer of sites (precise

Ordnance-Survey locations, rankings of the state of preservation, and citations to published works); and a comprehensive bibliography.

Unluckily, the author was not well served by his publisher. The copy-editing is not what one might expect or hope from a Yale imprint: several times per page I had to re-read sentences from which all commas between clauses were absent¹⁰, and there are other instances of ambiguous or baffling meaning; there is peculiar capitalization like “Seminole indians”, and puzzling mis-spellings: “group” presumably for “ground” on p. 69, “prediction of ellipses” (sic, presumably for “eclipses”) on p. 166; and twice on p. 201, areas are expressed in m³ instead of m².

But the substantive content of the book is authoritative, comprehensive, thoughtful, highly informative. Everyone interested in megalithic civilization will want at least to scan it and frequently to consult it.

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Notes

¹ The Gaelic term for the English is “Sassenachs”, probably derived from “Saxon”.

² The huge size of many stones found in and associated with some circles, rows, and burial chambers is reflected in the prefix “mega”. However, remains of the “megalithic culture” include many sites in which many or even all of the stones are of less impressive size. The culture spans a time period of several millennia, from the early Neolithic to the late Bronze Age, roughly 4000–5000 BC to roughly 1000 BC.

³ Aubrey Burl, *The Stone Circles of the British Isles*, New Haven, Connecticut: Yale University Press, 1976.

⁴ The most common form of carbon, C-12, has atoms whose weight is 12 atomic units. The radioactive isotope C-14 is formed continuously in the upper atmosphere and percolates through the carbon cycle of living organisms: carbon dioxide is absorbed by plants, and the plants are eaten by animals. So long as an organism lives, it exchanges carbon with its environment and the ratio of C-12 to C-14 in it remains the same. At death the exchange ceases, and the amount of C-14 declines as the radioactive atoms decay. Knowing the rate of that decay and the ratio of C-14 to C-12 in a given specimen, one can calculate how long ago death occurred. Usefully accurate dates from a few centuries ago to as much as 50,000 years ago can be obtained in this way.

(Willard Libby was awarded the 1960 Nobel Prize in Chemistry for developing this wonderfully useful tool. Corrections are nowadays made for the fact that the amount of C-14 in the atmosphere has not remained constant over the relevant period of time. For the last few thousand years, accurate corrections have been possible by correlation with the annual growth rings of trees.)

⁵ Earthen mounds, considerably longer than they are wide, containing long passages lined with stone slabs and side-chambers to hold remains of the dead.

⁶ Thom thought to have identified a “megalithic yard” of 0.823 m.

⁷ For example, Callanish on the Isle of Lewis in the Outer Hebrides or the Isle of Arran in southwest Scotland.

⁸ A modern and maybe far-fetched analogy might be in Australia’s capital city, Canberra, where each country has built its embassy in the style of that country’s traditional architecture.

⁹ Each cycle being 18.6 years, so that 56 is the smallest whole number that corresponds closely to an integral number of cycles.

¹⁰ For example: “The connection with a sky-god is clear for in western England the axes were thought to be thunderbolts and in an interesting link with fire cottages in Ireland often had a stone axe placed in their rafters as protection against lightning” (p. 68); “Early though it was the particular Carrowmore combination of a flat-topped cairn lying inside a free-standing ring of tall stones never developed” (p. 82); “Whatever the ceremonies here they were interrupted when the site was converted into a cemetery” (p. 292).

DMT: The Spirit Molecule by Rick Strassman. Rochester, Vermont: Park Street Press, 2001. 378 pp., \$16.95, paperback. ISBN 0-89281-927-8.

This book is a narrative of the author’s experiences conducting research in which he injected volunteers with dimethyltryptamine (DMT) and other psychedelics during the 1990s at the University of New Mexico. Strassman sets the scene by discussing psychedelics, neurotransmitters, DMT, and the pineal gland. He hypothesized that the pineal gland produces high levels of DMT at critical times in one’s life, such as spiritual events and death. He reasoned that if his hypothesis were true, then administering DMT to participants in a study should evoke effects that would be similar to effects experienced in those states. However, obtaining approval to administer a Schedule I drug to volunteers is not an easy matter and Strassman recounts the labyrinthine bureaucratic process that he had to endure in order to get his experiments underway. The main body of the book consists of the reports given by participants of their experiences under the influence of DMT. Strassman concludes by describing the factors that led to the termination of his research program and discussing the implications of his results.