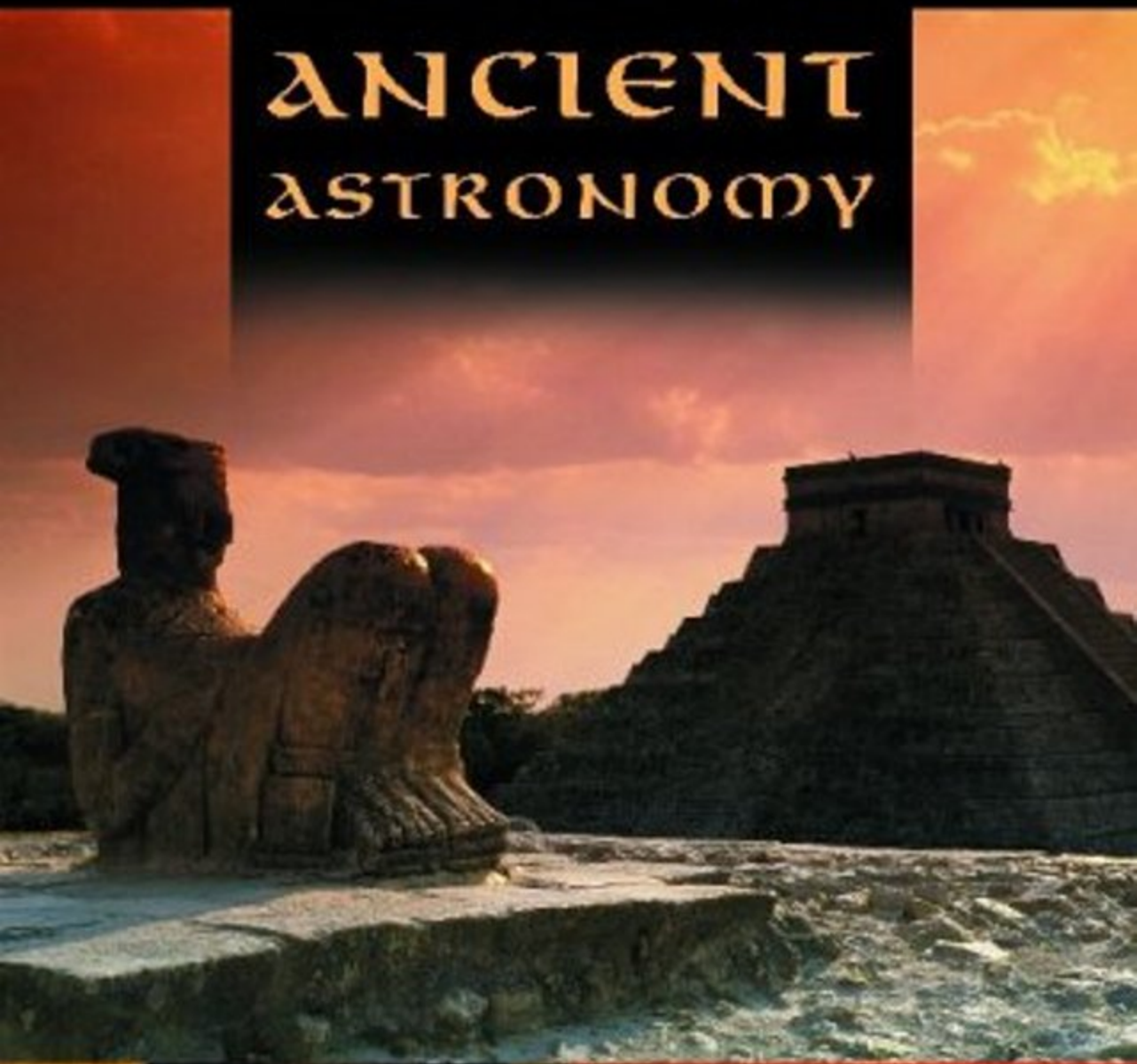
An Encyclopedia of Cosmologies and Myth

ANCIENT ASTRONOMY



Clive Ruggles

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An Encyclopedia of Cosmologies and Myth

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Introduction

The Wonder of the Skies

The sight of a truly dark night sky is simply breathtaking. In the modern world it is denied to all but those who still live, or might occasionally venture, well beyond the glare of city lights and the effects of atmospheric pollution. For people in the past, though, the panoply of thousands of stars was a familiar sight. Some twinkled particularly brightly; others hovered on the borderline of visibility. A few were tinted orange or blue. They formed distinct patterns that moved around but never changed. The Milky Way was a familiar sight to all, snaking across the heavens with its light and dark patches forming recognizable shapes. The sky also contained numerous isolated faint and fuzzy objects (nebulae), fixed among the stars, as well as bright wandering stars (planets), and of course the moon, dominating the night sky, lighting the way by night, and rendering many of its fainter companions temporarily invisible. Added to all this was the occasional appearance of something rare or totally unexpected: a shower of meteors (shooting stars), a lunar eclipse, an aurora (at high latitudes), or—more seldom still—a comet (often perceived as a tailed or plumed star) or a new star (nova).

The exact appearance of the heavenly vault differed from place to place and time to time. Whether it was visible on a particular night was dependent, of course, upon local weather conditions. However, the visual impact of the sky on a clear night was always stunning, and even in the cloudiest and wettest of places there were a good many clear periods. As a result, human communities the world over, and for many thousands of years, have recognized familiar patterns and cycles of change in the skies, as well as unexpected sights and events, and struggled to make sense of them. The inhabitants of the night sky—whether perceived as animals, fantastical creatures, legendary characters, ancestors, or other entities—were ever present. The cycles of their appearance and disappearance provided the basis for, and reinforced, countless creation stories and cultural myths.

The lack of opportunity to experience the true night sky is, for a great many people in the modern Western world, something beyond their control. The same cannot be said, though, of the daytime sky, and yet few people pay much attention to it beyond worrying about the weather. Only a meager proportion—and

this does not just apply to city-dwellers—could, for example, orient themselves from the time of day and the position of the sun, or could accurately describe the way in which the sun's daily arc through the sky changes with the seasons.

As a result, it can be difficult for us to imagine just how great an impact the sky, whether by night or day, had upon human cultures in the past. Yet we need look no further than the many indigenous peoples today for whom the sky continues to be of immense importance. In addition to this, certain world religions such as Islam continue to tie daily and annual observances very explicitly to the appearance of the sun and moon (see ISLAMIC ASTRONOMY). And one only has to talk to some of the older people living in rural areas, even in the world's most densely populated and developed nations, to discover that an immense amount of practical, everyday sky knowledge was possessed even within living memory. Who, sky watchers of the past might wonder, could fail to notice the regular cycle of lunar phases keeping time with the human menstrual cycle? Who could fail to recognize the changing path taken by the sun through the sky, higher in summer and lower in winter? Who, even in an unfamiliar place, could fail to be able to tell directions and hence find their way about by night or day using the sun or stars?

Perceptions of the Skies in the Past

ARCHAEOASTRONOMY can be defined as the study of beliefs and practices concerning the sky in the past, especially in prehistory, and the uses to which people's knowledge of the skies were put. It has been recognized in recent years as a legitimate and worthwhile academic pursuit, but it also strikes a popular chord, bringing together two of the most attractive sciences, archaeology and astronomy. It combines the excitement of the cosmos with the romance of the past. Books making spectacular claims about ancient astronomical knowledge often find themselves on bestseller lists. But why should studying people's perceptions of the skies in history, let alone in prehistory, be of particular interest or importance to scholars, not to mention anyone else, in the twenty-first century?

One reason is that archaeoastronomy gives us important insights into how people in the past made sense of the world within which they dwelt. People's lives were governed by observations of objects and events in the world around them. On one level, it is obvious that human communities needed to keep track of various seasonal markers in order to control and maintain their food supply through the year. This would be true whether they subsisted by harvesting plants, fruits, and tubers, by fishing, by hunting, by herding animals or by growing crops, or (most commonly) by a combination of these. CALENDARS, however rudimentary, were necessary for survival in all types of human society: for the smallest bands of hunter-gatherers; for farming villages controlled by local chiefs; and for complex urban societies seeking to support the higher social echelons of elite specialists, craftsmen, priests, and kings.

But humans share a deeper need to understand the world that they inhabit. This does not necessarily mean seeing humankind (or the human mind) as existing within the "objective reality" of the natural environment, as is the modern scientific view, but more generally perceiving the cosmos as a conceptual whole with oneself and one's own community embedded within it. In such a view of the world, the human body, or the dwelling house, or the sacred temple, is often seen as a microcosm reflecting and reinforcing the nature and structure of the cosmos as a whole. Such a worldview makes people strive to be at one with the cosmos of which they are a part and achieve a harmony of existence that enables individuals and whole communities to survive and flourish. This harmony is sustained by continually observing what is happening in the world and keeping one's own actions in tune.

The sky was an integral and prominent part of the perceived cosmos. Its familiar sights and unceasing cycles were part of the fabric of life. Its rhythms were correlated with the time of day and with the seasons. In fact, although we know these cycles to be unfailingly regular and reliable, to past peoples they may not have appeared any more so than a host of other seasonal indicators in the world around them. The important point for us is that, unlike the rest of their perceived world, the sky is a part that we can visualize directly. Landscapes change: patterns of settlement and land use alter, people move around, plants constantly grow and die. We only have indirect knowledge of the appearance of past landscapes. But thanks to modern astronomy, we can reconstruct mathematically the actual appearance of the sky (or, at least, the regular aspects of it—that is, the appearance of the sun, moon, planets, and stars) at any place on earth at any time in the past and visualize it on a computer display or in a planetarium. This gives us a "direct view" of a prominent part of the world that was perceived by peoples in the past.

By studying knowledge passed down orally through myth and story, as well as a variety of other types of evidence available to the historian and the archaeologist, we can begin to appreciate the many different ways in which human societies came to understand what they saw in the skies, and how they came to "use" that knowledge for cultural ends. The sky could, for instance, affirm the POWER of cultural elites, as in the case of the Inca rulers, whose right to rule stemmed from their avowed relationship to the sun god himself (see *CEQUE* SYSTEM; CUSCO SUN PILLARS). Then again, it could reinforce the status of a shaman or priest who, by performing the appropriate rites at the appropriate times, could be seen as able to affect what happened in the sky—for example by reversing the direction of the sun at the winter solstice and preventing the days from getting ever shorter and colder. Likewise, people tend to lay out buildings in tune with the cosmos, in other words, reflecting perceived links with the wider world (see, for example, NAVAJO HOGAN; PAWNEE EARTH LODGE). Where these links relate to the sky—for instance, to the rising or setting position of the sun, moon, or stars—then we have particular hope of recognizing them, since we know where these celestial bodies ap-

peared in the past (see HOW THE SKY HAS CHANGED OVER THE CENTURIES). By studying architectural alignments upon sky phenomena, we can obtain valuable insights into the worldviews that engendered them.

There is no reason investigations of people's perceptions of the skies should be limited to past societies, and a field known as *ETHNOASTRONOMY* has emerged in recent years alongside archaeoastronomy, concerned with studies of beliefs and practices relating to the sky among modern indigenous peoples. Since there is no hard line between past and present, many scholars prefer to merge the two fields and to speak instead of *cultural astronomy.* Regardless of how the subject is divided up, the study of people's perceptions of the skies has a deep resonance and helps us appreciate the richness and diversity of human cognition and belief (see COGNITIVE ARCHAEOLOGY).

This said, our knowledge of particular practices is always indirect, whether the evidence we are working with is ethnographic, historical, or archaeological, and questions of METHODOLOGY are highly important. For example, when studying an astronomical alignment (such as a building or temple oriented upon solstitial sunrise) it is necessary to have reasonable confidence that the alignment was actually intentional. This is not self-evident, since everything must, after all, point somewhere. In the 1970s, an abyss developed between two groups of academics regarding the interpretation of British megalithic monuments (see MEGALITHIC MONUMENTS OF BRITAIN AND IRELAND). On the one side were those who paid great attention to STATISTICAL ANALYSIS but little to anthropological theory and tended to argue that "MEGALITHIC ASTRONOMY" was highly mathematically sophisticated. On the other were those who did the reverse and reached the diametrically opposite conclusion: that ancient peoples had no interest in the sky at all.

To get past this impasse, it is important to distinguish between "our" science, which provides tried and tested methods for fairly selecting and assessing evidence, and "their" science, the worldview (ancient, historical, or indigenous) we are interested in (see PALAEOSCIENCE; SCIENCE OR SYMBOLISM?). Those who are mathematically adept but anthropologically naive tend to try to show, in a proprietary way, that people in the past were our intellectual equals by demonstrating that they were capable of sophisticated mathematics and astronomy. The flaw, and also the irony, in this approach lies in the desire to measure the achievements of a past society against the yardstick of our own. This tendency, well known to anthropologists as ETHNOCENTRISM, amounts to putting our own culture on a pedestal. It is necessary to recognize that the worldview we are studying might well be logical enough in its own terms even though it does not conform in every respect to our rationality, since it is built upon different assumptions and principles. A few thousand years is nothing in human evolutionary terms, and thus people living a few thousand years ago were undoubtedly our intellectual equals: however, their way of thinking was different. We pay respect to that difference by trying to understand their way of thinking in its own terms rather than trying to

make it conform to ours. It is for this reason that many prefer to avoid using the singular term *astronomy* to describe ancient peoples' interest in the skies, speaking instead, if they use the term at all, of ancient *astronomies*.

All people develop a personal view of the world. It is influenced by their own memories and experiences in which any things that may be perceived—objects, places, events, people and their actions, other living creatures, and plants—can acquire particular meanings, as can the relationships perceived to exist between them. What is more, among the countless things that make up an individual's experience, some come to acquire more significance than others, in a selection process that can seem, to an outsider, highly arbitrary. A "discovery" that seems important to one person may be entirely overlooked or simply of no interest to another. Thus one of the Mursi, a modern group of cultivators and herders living in southwestern Ethiopia, determined the number of days that had elapsed between the planting and first harvesting of his sorghum crop by wearing a cord round his ankle and tying a new knot in it each day. However, those to whom he proudly announced the result were mildly surprised that anyone should have taken so much trouble to deduce something so irrelevant to their daily lives—something that added nothing to their total stock of knowledge about the world.

Groups of people living together do, however, tend to develop common *mindsets*—sets of common perceptions and understandings. These worldviews are reinforced by shared experiences and social convention, and by regular communication, which in small groups is likely to take place by means of a common language. In the framework of modern Western thought, we organize what we perceive in nature according to the principles of Linnaean classification (deriving from the work of the eighteenth-century Swedish botanist Carolus Linnaeus)—that is, into a hierarchical structure of groups (taxa) based upon their observable characteristics. We also tend to believe that the universe is an empirical reality existing independently of the human mind that can progressively be understood through rational argument and scientific experimentation. Other worldviews, however, do not generally classify objects and phenomena into taxa familiar from a Western viewpoint: categories and relationships are not determined by "objective" criteria but simply by whether enough people agree on them. As a result there is generally no clear distinction between the sacred and the mundane, the animate and the inanimate, the empirically real and the fantastic; nor indeed between the terrestrial and the celestial. In traditional cultures, creatures such as fish-man or bird-woman may be seen as fellow beings, every bit as much a part of the perceived universe as entities a Westerner would identify as physically real. As an example, Old Star, chief protector of the inhabitants of the sacred *He* world of the Barasana of the Colombian Amazon, is at once a short trumpet, a constellation corresponding to ORION, the fierce thunder jaguar, and a human warrior.

The sky is a crucial component in practically every indigenous worldview. For earlier peoples and for many indigenous groups around the world today, what

we in the modern Western world separate out and categorize as astronomical and meteorological phenomena were an integral part of the environment as a whole. This total environment, including things both real and imagined, *was* the cosmos; the words COSMOLOGY (as widely used in anthropological literature) and *cosmovisión* are broadly synonymous with worldview. In non-Western worldviews, direct associations between the terrestrial and the celestial are commonplace. A good example of this is the BARASANA "CATERPILLAR JAGUAR" CONSTELLATION, whose behavior is believed to relate directly to that of earthly caterpillars, which fall out of trees and provide an important food source at a certain time of the year.

Myths and Monuments

Where we have first-hand informants or can actually still witness long-standing cultural practices, we are in the strongest position to recognize aspects of other worldviews. Examples such as the modern Yucatec Maya village of Yalcobá in southern Mexico, where the structure of the cosmos is reflected in a whole variety of aspects of social behavior, show just how rich and complex these practices can be. Yet ethnographers can be misled by informants, especially if they ask the wrong questions—all too easy if they have very little initial understanding of the nature of the worldview they are studying. Added to this, sacred information is often withheld, or the anthropologist may not be at liberty to pass it on. There is also the additional danger that the ethnographer may succeed, unwittingly, in influencing the very worldview he or she is trying to investigate, so that a subsequent investigator is misled into thinking that certain modern knowledge was in fact indigenous. Finally, most of us are limited to approaching the cultural information indirectly, at best at second hand, which imposes a selectivity that is not of our choosing and a filter—that of the ethnographer's interpretations—through which we are forced to view everything.

Historical accounts, whether by indigenous people themselves or by past ethnographers, are subject to all the problems just mentioned together with some additional ones. For one thing, an author who is no longer alive cannot be questioned, so there is no possibility of clarification or elaboration. For another, in interpreting a historical account it may be critical to appreciate the context in which it was produced.

Ancient written records directly relating to astronomy exist not only among the civilizations of the Middle and Far East (see for example CHINESE ASTRONOMY). Perhaps the most extraordinary example produced in the American continent is the Maya DRESDEN CODEX, a pre-Columbian astronomical (or, more accurately, astrological) almanac. Both its complexity and level of detail are exceptional. In some cultures, other types of recording device encapsulated sacred information, including astronomical knowledge or calendrical data. One intriguing example is the QUIPU, bundles of knotted strings used in the Inca empire. A

much more widespread practice, which did not produce any form of written record, was to embed sky knowledge and cosmological beliefs within myths that were transmitted from generation to generation orally. Storytelling may have been entertaining, but it could also have the deeper purpose of passing on wisdom. Creation myths often served to confirm a community's rightful place in space and time, or to establish the genealogical credentials, and hence the social standing, of a king or leader. (Genealogies were not limited to human forbears. The KUMULIPO, a 2,000-line long Hawaiian creation chant composed in the eighteenth century, recounted in detail how chief Ka-ʻĪ-i-mamao was related, ultimately, to everything in the world.) Some sacred stories were carefully learned and recounted, often in the context of formal ceremonies. Other tales might change in the telling, bringing many variations down to us but leaving intact the essential underlying substance and meaning.

The further we delve into the past, the more we find ourselves limited to the archaeological record—the material remains of past human activity. Silent alignments of stone temples and tombs, interplays of sunlight and shade that light up dark spaces only on rare occasions, symbols with unfathomable meanings but which resemble the sun or moon or familiar groups of stars—these form many of the most famous manifestations of ancient astronomy. But they also present the serious scholar with serious methodological problems. Every oriented structure must point towards *some* point on the horizon, and in all likelihood to one or more identifiable astronomical targets. Similarly, the majority of entrances and openings will let in a shaft of sunlight at *some* time of the year and day. The mere existence of (say) a solar alignment is no guarantee that this meant anything to the builders of a house, temple, or tomb. Since astronomical alignments can—and frequently will—occur completely by chance, we must do more than simply "butterfly collect" them if we are interested in what they actually meant to people in the past. There are two ways of proceeding: either to seek statistical confirmation—for example, by identifying a group of several monuments in which a certain type of astronomical alignment occurs repeatedly—or by finding corroborating archaeological evidence of different forms. An example of the former is the RECUMBENT STONE CIRCLES of northeast Scotland, which have a consistent orientation relating to the moon. Two different examples of the latter, also from Neolithic and Bronze Age Britain, are the THORNBOROUGH henges (large round embanked enclosures) in Yorkshire, England, and the cairns at Balnuaran of Clava in Inverness, Scotland (see CLAVA CAIRNS).

In some cases, such as pre-Columbian Mesoamerica, we have both archaeological and other forms of evidence, including ethnohistory (accounts recorded during the early years of European contact), iconography, and written records (see "BROWN" ARCHAEOASTRONOMY). Integrating these diverse forms of evidence can be a considerable challenge. This problem is illustrated by the prolonged controversy that surrounded the putative Venus alignment at the so-called Governor's

Palace at the Maya city of Uxmal (see GOVERNOR'S PALACE AT UXMAL). Inscriptions on the building attest to a strong interest in the planet Venus, but the apparent orientation of the building toward an extreme rising point of the planet has generated much debate. In ancient Mesoamerica in general, the historical evidence relating to astronomy and calendrics is strong, and the archaeological evidence—for example in the form of alignments—tends to strengthen and corroborate this. If it were not for the accounts of the early Spanish chroniclers, the calendrical inscriptions, and the vital bark books (codices), we would simply have no idea of the sophistication and complexity of Mesoamerican astronomy.

In other places there can be a finer balance. The origins of a piece of oral history are typically much more obscure than the historical context of written records or inscriptions. It can be extremely difficult to separate genuine traditions and stories that stretch back over many generations from more modern inventions or infiltrations. In Hawai'i, a very rich oral heritage existed until the early nineteenth century, of which only fragments now survive (see HAWAIIAN CALENDAR; POLYNESIAN AND MICRONESIAN ASTRONOMY). Yet in assessing the significance of temple alignments in these islands, some of those surviving fragments may contain vital gems of information (see POLYNESIAN TEMPLE PLATFORMS AND ENCLOSURES). They are of uncertain provenance, so must be used with extreme caution, but one would be unwise to simply ignore them and revert to statistics alone.

Where the only available evidence is archaeological, it is possible to use analogies from different cultures where other forms of evidence exist to suggest interpretations. Thus in the 1970s, the Scottish archaeologist Euan MacKie attempted to use the analogy of Maya society to argue (in support of theories, popular at the time, that many of the British megaliths were high-precision observatories) for the existence of highly skilled astronomer-priests in Neolithic Britain (see "MEGALITHIC ASTRONOMY"; "MEGALITHIC" CALENDAR). However, this direct use of ethnographic or historical analogy is generally fraught with problems. Most archaeologists concluded, for a variety of reasons, that MacKie's efforts were badly misguided. On the other hand, analogies can be very useful in challenging assumptions that might have been made too unquestioningly, and hence in suggesting new interpretative possibilities. It is generally assumed, for example, that any people who observed the changing rising and setting position of the sun on the horizon over the year must have understood that this regulated seasonal events. Yet while it is true that some of the Mursi, already mentioned, track the changing rising position of the sun on the horizon, the MURSI CALENDAR is based upon the moon. The sun is regarded as no more reliable a seasonal indicator than the behavior of various birds, animals, or plants. The Mursi example stops us leaping to conclusions about practices in the past by showing us that the range of possibilities is wider than we might have imagined.

In summary, where we have only archaeological evidence to go on, it may be possible to gain insights into prehistoric worldviews by recognizing symbolic as-

sociations in the material record. Analogy may be useful in the process of interpretation, but our conclusions will never be categorical. We can only ever have a certain degree of belief that a specific association had meaning to a particular group of people, although our belief may be strengthened or weakened by further evidence.

From Tally Marks to Calendars

How did people begin to make links between different cycles of activity they observed around them and hence begin to understand and control the periodic changes in the natural world as they perceived it? At what stage did they start consciously to plan their own actions in accordance with those perceptions?

Groups of people from the earliest times would certainly have varied their subsistence activities in accordance with the seasons, whether these involved searching for edible plants and animals, fishing, or hunting. But in this alone they were little different from many others in the animal kingdom: many birds, after all, undertake seasonal migrations. Two characteristics that have distinguished humankind for several tens of thousands of years are people's capacity for abstract thought—making connections between things in order to satisfy the desire to make sense of them—and the use of symbolic representation to express ideas. There is ample evidence of the latter in the Upper Palaeolithic, in the form of systematic markings on many small portable objects such as pieces of bone. Their meaning is much debated, but it has been suggested that some at least represented rudimentary lunar calendars—tallies of days or some other sort of symbolic notation relating to the lunar phase cycle. The most famous example is a fragment of eagle's wing found in a cave at Abri Blanchard in southern France, dating to around 30,000 B.C.E. (see ABRI BLANCHARD BONE). Some much more recent, and less controversial, examples of possible lunar tallies among hunter-gatherers are found in rock art from northeastern Mexico. The site of PRESA DE LA MULA, near Monterrey, is one of two petroglyphs that seem to record counts of days stretching over seven synodic (lunar-phase-cycle) months, divided up according to the appearance of the moon. However, these designs were not calendars: they were clearly not intended for regulating future activities. Rather, they were first-hand observational records, with all the vagaries and imperfections this implies.

Counting days, as such, is unlikely to have been an overriding issue for most people in the past. They had to be aware of many different cycles of activity in their lives. One of the most effective ways of keeping track of things is through myth and appropriately timed ritual performance. These were invariably tied in, along with many aspects of living and being, with the unchanging entities in the sky and the ceaseless cycles in which they were seen to move. Stories help describe the world and explain why things are as they are. Ceremonies serve in a very active way to affirm the natural order. Stories and ceremonies also involve an ele-

ment of control, in that their successful performance, with adherence to strict protocols, is often seen as necessary—even vital—in order to ensure continuity, renewal, and growth. The appropriate rituals may ensure the arrival of the sun on a given morning, or bring about the reversal of the sun's winterward movement so that it will return and give greater warmth again each spring. Whether performed by a lone shaman, by whole communities working in unison, or by a powerful priest with the active participation of a controlling elite, rituals, ceremonies, and other performances can ensure that the order of the cosmos, and of the lives of the people within it, is duly maintained. The Blessingway and other sacred rites of the Navajo people are just one example of performances of this kind recorded in modern times and, in some cases, continuing to the present day, both among native Americans and among indigenous peoples around the world. The Blessingway ceremony serves to ensure good health, prosperity, and so on by preventing misfortune, and involves detailed renditions of the Navajo creation story (see NAVAJO COSMOLOGY).

What may be an extremely old tradition of myths and performances relates to the identification of two bears circling around the northern celestial pole. The evidence to support this assertion, paradoxically, is found in modern oral traditions across Europe. In the Basque country, the bears' motions around the celestial pole are linked to an annual cycle of storytelling and song and dance performances involving whole communities. Other variants are found throughout Europe. Constellation myths within the framework of Greek and Near Eastern thought form an integral part of the modern Western heritage, but the prevalence of indigenous bear myths suggests that two circumpolar bears are star figures emanating from much older cosmological traditions (see SKY BEARS).

In the 1969 book *Hamlet's Mill,* Giorgio De Santillana and Hertha Von Dechend suggested that specific astronomical knowledge—namely the gradual shifting of the entire mantle of stars over the centuries due to a phenomenon known as PRECESSION—had been systematically "encoded" in mythological narratives all over the world over a period of many millennia. There are various problems with the evidence presented in support of this idea, but there is also a fundamental difficulty with the idea itself. It presupposes an almost universal concern in ancient times with a particular concept (precession) familiar to ourselves. This is very different from arguing that some communities in certain places and times might have had stable enough cosmologies—sky knowledge passed down accurately enough over several generations—to have noticed the gradually changing appearance of the sky and attempted to come to terms with it in one way or another.

The point about the sky bears, on the other hand, is that we may be glimpsing an ancient framework of understanding very different from the Western one. According to the American linguist Roslyn Frank, who has investigated the relevant European folk traditions in detail, it was a framework in which earthly bears were venerated. She argues that a human individual playing the role of a bear

shaman acted to maintain the cosmic order, organizing the cycle of earthly ceremonial in tune with the annual cycles of the stars. If Frank is right, then we should not look back to some sort of universal, all-prevailing myth or cosmology, diluted with time, but rather to one that always coexisted with many others. One would have to argue that it achieved particular prevalence at high northern latitudes because it brought together what was seen on earth and in the sky in a particularly effective and understandable way; thus it tended to propagate, encountering and mixing with other traditions, and eventually leaving traces visible in folk traditions to this very day.

Another way in which a people can affirm the perceived cosmic order is by carefully timed movement through the landscape. The Lakota people of South Dakota, for example, traditionally keep their subsistence activities in tune with other seasonal cycles by moving from one place to another in an annual pattern that, as they see it, reflects the sun's movement through the constellations (see LAKOTA SACRED GEOGRAPHY). Their annual round combines subsistence activities focused upon the terrestrial movements of the buffalo, with sacred rites focused upon the celestial movements of the sun. In doing so, it ties together earth, sky, and people into a comprehensible whole, thereby keeping everything in harmony. The Mursi of Ethiopia perceive a direct connection between the successive disappearance of four bright stars in the southern sky and events on the ground related to successive floods of the river Omo. This enables them to time their annual migration to the banks of the Omo precisely enough to carry out the vital planting of their crop of cowpeas within a few days of the river's final flood.

Can we hope to find, in the material record, evidence of astronomically timed movement through the landscape in the past? If we could determine the times of year when certain sites or locations were occupied, and if we could spot symbolic links between these places and the sun or stars, then it is certainly possible that this could give us some clues. Symbolism relating to a solstice, at a site that is occupied around the time of solstice, is one possibility. It has been suggested that CHACO CANYON in New Mexico was a focus for sacred pilgrimage for Anasazi (ancestral Pueblo) communities in the surrounding area around the eleventh century C.E. The archaeological evidence for this is supported by archaeoastronomical evidence that people in the outlying communities used astronomical observations to synchronize their convergence upon Chaco. Another, much older, example of a similar phenomenon occurs at THORNBOROUGH, a group of Neolithic henges in Yorkshire, England. Here the archaeoastronomical evidence consists of a series of alignments upon the rising position of the three stars of ORION's belt, suggesting that it might have been the first predawn appearance (HELIACAL RISE) of this asterism that triggered an annual PILGRIMAGE for an autumn festival at the henges.

In modern indigenous societies, we see ample evidence of the various ways in which people strive to harmonize what they do with cycles of events in the nat-

ural world. Studies of tally counts, astronomically related myth and ritual performance, and patterns of ritual movement have begun to reveal some of the ways in which this may have been done in the past. CALENDARS—self-consistent systems of marking time—developed from these more rudimentary perceptions of correlations between different cycles of activity in nature, and the desire to keep human activities—ones that we might identify as sacred, mundane, or having aspects of both—in tune with natural events. The cycles of change of the celestial bodies—regular, immutable, and reliable—are clearly of particular importance in this context.

It is commonly assumed that there is a natural progression of calendrical development relating to astronomical observation. The first step is to develop a simple month-by-month calendar based on the phase cycle of the moon, the most obvious cycle in the night sky. However, because there are between twelve and thirteen synodic (phase-cycle) months in a solar year, it follows that in order to keep in phase with the seasons, one needs to have twelve months in some years and thirteen in others. The second step, then, is to take note of phenomena that are related to the seasons, including astronomical ones, using them to keep lunar calendars in pace with the seasonal year by inserting or omitting a month from time to time as required (see LUNAR AND LUNI-SOLAR CALENDARS). The ancient Egyptians, for example, used the first predawn appearance (heliacal rise) of Sirius, the brightest star in the sky, to keep the start of the new year in step with the annual flood of the Nile. Sirius would have been first seen approximately eleven days later in the twelfth month each year. Whenever it did not appear until the last few days of the twelfth month, then an extra or *intercalary* month was added so that it would continue to rise in the final month of the following year.

A seasonally related phenomenon of particular importance is the changing rising or setting position of the sun along the horizon (see SOLSTICES, SOLSTITIAL DIRECTIONS). Once a society recognizes this, they can use it to regulate a solar calendar that is entirely independent of the moon. If the horizon is sufficiently distant and contains a good many distinctive points, then such a calendar can quite easily be kept accurate to within two or three days of the "true" solar year. One of the classic modern examples of a solar horizon calendar is that of the Hopi people of Arizona. As first recorded by the ethnographer Alexander Stephen at the end of the nineteenth century, solar horizon observations were used by the Hopi both to regulate crop-planting activities and to pinpoint events within an elaborate ceremonial calendar (see HOPI CALENDAR AND WORLDVIEW).

The final step in the development of luni-solar calendars is to replace the ad hoc insertion or omission of intercalary months by a systematic procedure. By about the fifth century B.C.E., the Babylonians had developed a fixed system whereby a thirteenth month was inserted into seven different years, in a fixed pattern, within every period of nineteen years (see BABYLONIAN ASTRONOMY AND AS-

TROLOGY). This *Metonic cycle,* named after the Greek astronomer Meton, keeps the lunar calendar in step with the solar year to within an error of just one day in every 200 years.

The Babylonian calendar was an impressive achievement made possible by systematic astronomical observations recorded over many generations. However, ancient calendars do not inevitably follow the progression just described (and even in Babylonia itself, calendrical developments were more complicated). The Mursi yet again provide a good example. They have what, to an outsider, looks like a thoroughly haphazard calendar in which no one ever seems to know for certain what month it is, although everyone believes there are "experts" around. In practice, different opinions always exist, and the calendar is effectively adjusted "on the fly" according to various seasonal markers—though no one is aware that these adjustments are being made. The calendar is completely self-consistent in its own terms, and there is no need for intercalary months. The nearby Borana have a completely different and utterly distinctive luni-stellar calendar that reckons the time of the month and year by observing the moon in relation to the stars, completely ignoring the sun (see BORANA CALENDAR). The *Works* part of HESIOD's *Works and Days* describes farmers' rules of thumb in eighth-century B.C.E. Greece that related exclusively to seasonal astronomical phenomena such as the heliacal rising of stars; the lunar phases are only mentioned in the separate *Days* part. The Roman civic calendar, upon which the modern (Western) calendar is based, only emerged from chaos when it ignored the moon completely (see ROMAN ASTRONOMY AND ASTROLOGY). On the other hand, uncorrected lunar calendars remain of considerable importance to this day, one of the most obvious examples being the Islamic calendar (see ISLAMIC ASTRONOMY). Finally, the ancient Mesoamerican calendar, arguably the most sophisticated and complex of all the world's calendars, operated by combining cycles as diverse as the 365-day year, a 260-day cycle (whose astronomical derivation, if it is astronomically derived at all, remains unclear), and the 584-day synodic cycle of the planet Venus (see MESOAMERICAN CALENDAR ROUND).

In short, there is no inevitable path in the development of calendars. Instead, they advance in diverse ways according to local conditions and needs. This means, for one thing, that they cannot be used as yardsticks of cultural achievement. It also means that they cannot be considered as abstractions, divorced from the social context in which they developed and the social needs that they fulfilled. The Hopi calendar, for example, had (as we would see it) both a pragmatic and a sacred function, but from the Hopi perspective it functioned holistically to ensure the well-being of the community in all respects. Different calendars can have different purposes and even run alongside one another, as—it appears—did the religious and administrative calendars in ancient Egypt (see ANCIENT EGYPTIAN CALENDARS). To the historian or archaeologist, understanding the technical aspects of an ancient calendar is often of limited interest. It is much more intriguing (and of-

ten much more challenging) to understand how a calendar operated in its social context, what it meant to people, and what its social implications were.

Modern folk calendars and associated traditions that still exist in many parts of the world, particularly in rural communities, often preserve an inherently holistic worldview, integrating earth and sky in a mixture of what the modern scientist would be inclined to view as rationality and superstition. In the Baltic States of Latvia and Lithuania, for instance, a mixture of prognostications survives that relate people's character, health, and happiness to the phase of the moon at the time of their birth and at important moments in their lives. This Baltic tradition leads to a related issue: the role of ASTROLOGY. The history of astronomy is clearly intimately bound up with the history of astrology; the distinction between the two is only an issue in the context of the modern scientific way of understanding the world. Taking an anthropological viewpoint, we must realize that systems of thought including beliefs that we might describe as "astrological" may themselves constitute ways of understanding the world that are perfectly coherent and logical in their own terms. Thus by considering the biblical skies from the point of view of the astrologers of the time, rather than simply as modern astronomers, a very plausible solution has recently been suggested to the riddle of the identity of the STAR OF BETHLEHEM, which has perplexed astronomers for years.

Ancient peoples generally did not share the modern conception of time as an abstract entity, as a line along which we move through our lives (see SPACE AND TIME, ANCIENT PERCEPTIONS OF). The earliest calendars almost certainly did not come into being as a result of simply conceived astronomical observations undertaken in order to mark the passage of abstract time. They emerged in the context of complex views of the universe in which many aspects of natural and human activity were seen as tied together in fundamental ways. This concept is of vital importance when we try to interpret archaeological monuments that appear to have incorporated alignments marking sunrise or sunset on particular calendrical dates. A fundamental question is: Which regular astronomical events might have been significant to people in the past? Alongside the SOLSTICES, the EQUINOXES are widely assumed to have had inherent significance, yet many investigators have been surprised to discover the absence of equinoctial markers in the culture they are studying. From the point of view of the observers themselves, however, there is a clear difference between the two. The solstices are tangible: at these times, the sun reaches the physical extremes of its motions along the horizon. The SOLSTITIAL DIRECTIONS mark the boundary between those parts of the horizon where the sun can rise or set, only passes over, or is never seen. These define a natural division of the world, as seen from any central point of observation, into four parts. The equinoxes, on the other hand, would in practice only have been observable as halfway points between the solstices. They would generally have been no more likely than any other date in the year to be correlated with any of the other seasonal events that would actually have meant something to people. The midpoint,

whether in time or space, seems significant only if one views time and space in the abstract. This is not to deny that particular groups of people in the past may have chosen to divide the year into four roughly equal divisions, but we can not simply assume that the equinox was a significant calendrical date for all.

Interpreting the Archaeological Record

As we have seen, astronomy helps us learn how the cosmos was perceived and understood in the past based on evidence we can retrieve from the material record. The "raw resource" is directly accessible to us: within certain boundaries of error we can reconstruct the positions of the sun, moon, stars, and planets in the night sky at any place and any time in the past. This means that we can readily identify ways in which ancient architecture could have made reference to celestial objects and events. But we must retain a sense of proportion. The astronomical ORIENTATION of a monument, to take an example, might only have conveyed meaning to a few people around the time of its construction, whereas the monument would also have been significant to people in many other ways, communicating meaning by way of its form, the materials used, and other aspects of its location.

In recent years archaeologists have applied a variety of interpretative approaches to the study of how people in the past conceptualized the LANDSCAPE. Yet *landscape* itself is a limiting if not excluding term. Its use reinforces a Western conceptualization of space that divides the world into three distinct parts—land, sea, and sky—and then, more often than not, leads us to ignore two out of three of these. Contrast this concept of landscape with that of the indigenous person who would, without hesitation, identify numerous connections between objects and events in the sky and many other aspects of his or her experience. In dealing with past as well as modern indigenous societies, the term *worldview* should mean exactly that: a people's understanding of the totality of the perceived environment.

The evidence available to the archaeologist consists of a present-day landscape containing scattered traces of past human activity, the end result of centuries—even millennia—of processes of attrition that have served to modify and to destroy. Archaeologists can look at the remains of permanent structures such as houses, tombs, and temples, and examine their location as well as architectural features that seem to express associations with features in the visible landscape and objects in the sky. Other human activities leave traces that are fixed in space, such as rock art (see PRESA DE LA MULA; SWEDISH ROCK ART). Beyond this are numerous types of material evidence, such as small artifacts, which are not fixed in space but may still tell us a great deal in various ways.

A well-tried approach is to try to identify alignments that were deliberately incorporated in architecture or in the location of manmade structures in relation

to other prominent features in the landscape. The latter approach has been successful in central Mexico, where the day of sunrise or sunset behind prominent mountains as viewed from certain pyramids and palaces has been found to correlate with calendrical ceremonies performed in sanctuaries built on those mountains. The hilltop palace of CACAXTLA, built in what is now the Mexican state of Tlaxcala in the seventh century C.E., was located directly on a preexisting alignment connecting an older ceremonial site with La Malinche, a prominent volcanic peak still important today as a source of rain and symbol of fertility. The times in the year when the sun rose behind this mountain from Cacaxtla and other temples in the alignment marked two important calendrical festivals and times of ritual pilgrimage. The observances survive, in the form of Christian festivals, to this day.

In this instance ethnohistoric and ethnographic evidence confirms the meaning of symbolic alignments. Where such evidence does not exist, identifying meaningful alignments is much more problematic. Clearly, it is possible to identify alignments between manmade structures and natural features that are in fact totally fortuitous and had no meaning whatsoever to anyone in the past. One possibility is to look for (what seem to us to have been) the most prominent manmade and natural features in the landscape in order to examine possible alignments of significance between them. But even this may be misleading. Mursi sun watchers stand by a favorite boulder or tree to make observations rather than erecting a more permanent marker that would be evident in the archaeological record of the future. Many important dates in the Hopi solar horizon calendar are marked by tiny, inconspicuous skyline notches, while many more conspicuous horizon features are unused. Furthermore, there is generally no obvious natural feature (such as a prominent notch or peak) in the solstitial directions, important as these actually were and are to the Hopi. The reason is that traditional Hopi villages from which observations were made were not located with regard to astronomy and calendrics. Walpi, for example, is perched on a narrow cliff-top mesa: its inhabitants had a given horizon and could not move their position of observation except within very narrow margins in and around the village. They did make precise horizon observations, but this fact would not be recoverable from the archaeological record alone. Any future archaeologist proposing that these particular alignments were significant would be open to the accusation of being highly selective with the data.

In other cases, however, evidence of horizon observations might be more readily identifiable in the archaeological record of the future. The Zuni, for example, had sun-watching stations used for horizon observations prior to the summer solstice. And the inhabitants of the Polynesian island of MANGAREVA established observation places for noting the summer and winter solstices against suitable landmarks, such as adjacent islets or mountain ridges, often erecting stones upon them as foresights. This example bears some similarity to the interpretation of many of the British megaliths, erected in the third and second mil-

lennia B.C.E., put forward in the mid-twentieth century by the Scottish engineer, Alexander Thom (see THOM, ALEXANDER). Basing his conclusions upon surveys of many hundreds of STONE CIRCLES, SHORT STONE ROWS, and single standing stones, Thom concluded that "megalithic man" had undertaken high-precision observations of the sun and moon using distant mountainous horizons as the observing instrument. The megaliths, according to Thom, marked where to stand and, in many cases, pointed out the horizon foresight (such as a conspicuous notch between two mountains) that was to be viewed.

Thom's results did not stand the test of time. One reason is that his data set included a wide variety of sites spanning a wide geographical area and a period of some two millennia (see MEGALITHIC MONUMENTS OF BRITAIN AND IRELAND). Subsequent analyses that have been restricted to certain areas during particular periods, and have taken account of a wider range of archaeological evidence, have been more successful. The Scottish RECUMBENT STONE CIRCLES (RSCs) are particularly enlightening in this respect. These are a group of several dozen stone circles confined to an area within about fifty kilometers (thirty miles) of Aberdeen in northeastern Scotland. Their distinguishing feature is a single recumbent stone flanked by two tall uprights, which are without exception oriented between west-southwest and south-southeast, that is, within a quarter of the available horizon. Furthermore, they are consistently aligned upon the midsummer full moon, suggesting that ceremonials were carried out there when the midsummer full moon was passing low over the recumbent stone. This is a conclusion backed up at one excavated site, Berrybrae, where scatters of quartz and burned flint—white stones whose color is similar to the light of the moon—were found in the vicinity of the recumbent stone. However, more recent excavations at other sites have confounded the issue.

The RSCs were modest monuments, apparently serving relatively small farming communities around 2000 B.C.E. Aligning them upon the moon at an important time, and also if possible upon a conspicuous feature in the landscape such as a prominent hill (as is the case at many but not all of the circles), tied them into nature in two different ways. This almost certainly served to reinforce the sacred status of the monuments for the people they served. It seems likely that society in this area at the time never became centrally organized and controlled, and this has bequeathed to us a set of small, similar monuments among which we can easily spot repeated patterns. This enables us to catch a glimpse of some aspects of ritual tradition and worldview—a glimpse that points strongly to the moon as a principal focus of attention. Similar conclusions have been reached in investigations of SHORT STONE ROWS in southwest Ireland.

A step on from identifying and interpreting monumental alignments is to ask why the monuments were placed where they were and not elsewhere. Answering this question involves a detailed investigation of whole landscapes to identify potential alternative locations. Such an investigation was carried out in the late 1980s in the northern part of the Isle of Mull, off the west coast of Scotland. It

showed that a set of five stone rows found there, apart from being consistently aligned upon the moon, were all placed so that Ben More—the most conspicuous mountain on the horizon in the area—was on the very margin of visibility, clearly in sight to one side of each row but completely hidden by intervening ground from the other. One suggestion is that the stone rows' main significance was as some sort of symbolic boundary marker between areas from which this (sacred?) mountain was, and was not, visible.

One supposition that emerges from these studies of monuments incorporating astronomical alignments is that many of them became "special" when the astronomical body in question appeared at the appointed place. At these times, their sacred power was surely reinforced. Another way in which a similar effect could be achieved—creating a very considerable visual impact at certain special times—was through the interplay of sunlight and shadow. Widespread evidence indicates an interest in creating carefully orchestrated interplays of shadow and light at sacred places, sometimes producing special effects visible on only very rare occasions. A famous example occurs at the passage tomb of NEWGRANGE in Ireland. Here, for a few precious minutes after sunrise on a few days around winter solstice, the dark interior of the tomb becomes lit up by sunlight shining directly down the passage. Even in the present day, such *hierophanies* can capture the imagination and become the focus of great public spectacles, whether or not they were actually intended by the builders. A case in point involves the pyramid of KUKULCAN (El Castillo) at Chichen Itza. It contains a staircase on each of its four sides, and at the base of the northern staircase is the carved head of a serpent. On days close to the equinoxes, the light of the late afternoon sun falling across the stepped corner of the pyramid creates the effect of a serpent's body, which only "appears" at these times. This spectacle now attracts tens of thousands of visitors. In contrast to Kukulcan, no serious doubts exist that the Newgrange hierophany was actually intentional; though, by its nature, it could never have formed a great public spectacle, since the space inside the tomb was confined. This dramatic effect was intended for the ancestors, or for ancestral spirits.

What was the purpose and meaning of such hierophanies? There is no simple answer, but further clues can be found by looking at more modest examples, often to be found in rock art. By carefully placing rock art designs, sunlight could be made to play across them at certain times, with impressive effect. A number of interesting examples are to be found in California, which was densely populated by hunter-gatherer groups prior to the European conquest. The Luiseño, for example, had an intense ceremonialism, a rich sky lore, and a calendar regulated by various astronomical observations. Although their seasonal calendar was lunar-based, they observed and celebrated the solstices, attaching particular importance to the winter solstice, which they regarded as a time of cosmological crisis. Solar imagery is evident at various Luiseño rock art sites, and light-and-shadow effects

have been discovered at three or four of them, more than one involving daggers of sunlight that bisect painted discs.

One of the most famous shadow-and-light phenomena concerns a petroglyph situated toward the summit of Fajada Butte, in Chaco Canyon (see FAJADA BUTTE SUN DAGGER). A carved spiral hidden away behind three slabs of rock leaning against a vertical rock face is occasionally lit up by the light of the sun shining through cracks in the rocks in front of it. Around noon on the summer solstice, however, a thoroughly distinctive dagger of light suddenly appears and bisects the carving. How should this be interpreted? Assuming that the slabs were carefully placed rather than falling into their positions naturally (and there has been some debate on this issue), it appears that a good deal of care was taken in positioning the spirals so that the summer solstice, and possibly other times of the year also, were clearly marked. The location is difficult to access but good for astronomical observation. Comparisons with the practices of historic Pueblos suggest that it might have been a sun shrine—a sacred place where a sun priest came to deposit offerings at certain important times in the ceremonial year. In this sense it would have been far more than a simple calendrical device. It was more likely something that, through its powerful symbolism, helped to affirm the sacredness of this inaccessible place, and by so doing helped to reinforce the power of the person or people who understood its meaning and had the privilege of using it.

As with astronomical alignments, we again encounter a methodological problem: just because we observe a shadow-and-light phenomenon does not mean that it was intended by the builders or had any special significance before our "discovery" of it. Given any pattern carved on a rock, what are the chances that the sun will play across it at some time, quite fortuitously, creating an unintentional effect? In the case of the Chaco petroglyph, more secure interpretations can only stem from wider evidence about Anasazi culture, perhaps with valuable clues from historic and modern Pueblo groups.

A different form of shadow-and-light phenomenon has been noted in Mesoamerica: the so-called zenith tube. ZENITH TUBES are vertical tubes incorporated in specialized ceremonial structures that marked the biannual passage of the sun through the zenith at noon, at which time sunlight could pass directly down the tube and light a chamber below. One of the most impressive examples is found at the ruins of Xochicalco in Mexico, where a tube more than five meters (sixteen feet) long opens into the roof of a natural cave artificially extended to form a rectangular gallery with three central pillars. The use of such tubes for the purposes of astronomical observation cannot be established with certainty but seems likely given the known significance of the ZENITH PASSAGE OF THE SUN in Mesoamerica, both from studies of the ancient Mesoamerican calendar and from modern ethnography.

Displays of light and shadow, especially if they occur only infrequently, can be highly impressive. It is easy to see how they could have conveyed symbolic power, reinforcing sacred associations that formed part of the fabric of the pre-

vailing worldview. Their presence in the archaeological record has the potential to reveal aspects of that worldview to us. The power to impress is conveyed to the modern investigator through direct experience—"being there" and experiencing the event for oneself has proved popular and is useful in generating tentative interpretations. But it also brings dangers. There is considerable potential for us to experience shadow-and-light phenomena that had no significance whatsoever to people in the past.

Great monuments also have the power to impress, none more so than STONEHENGE in England. Over the years it has attracted more than its fair share of theories, from the plausible to the plainly ridiculous. However, the general perception prevails that there was some sort of connection between Stonehenge and the skies, which accounts for its frequent appearance on the front covers of books on ancient astronomy. In the meantime, archaeological excavations have put some of these theories in a more secure context. The bluestone and sarsen circles, constructed around the middle of the third millennium B.C.E., replaced earlier timber constructions built within a circular ditch and bank that had been completed some 500 years earlier. The later stone monument was certainly a place of great power, and the solstitial alignment of the main axis, which all commentators agree was deliberate, represented a shift of several degrees from the earlier orientation. The transformation of the monument from timber into stone, the use of exotic stones from faraway places, and the sheer size and scale of the edifice strongly suggest a process of enriching the ritual symbolism of the site around 2500 B.C.E. to legitimize its place at the center of the cosmos and hence its ultimate power. This transformation probably served in turn to reinforce the earthly power and influence of a social elite. The change in the axis to incorporate the solar alignment was almost certainly part of the same process.

Modern Western science is only one of many frameworks of thought within which people all over the world, from Palaeolithic times to the present day, have gained an understanding of natural phenomena, including what could be seen in the sky. Modern science only seems the pinnacle of intellectual achievement from a Western perspective, and seeing it as such creates a tendency, when trying to comprehend non-Western modes of understanding, to single out particular "advances," seeing them as steps along the road. From an anthropological point of view, it seems stiflingly restrictive to proceed in this way when we can seek a much broader appreciation of different developments in human thought. This can only be achieved by studying the great many ways in which people have striven to comprehend the world that they inhabit and the many different contexts—physical and social—within which particular developments in thought have occurred. This applies just as much to sky knowledge as to all other knowledge. Above all, we need to recognize the magnificent diversity of human worldviews that has existed through time, and to respect them for what they were and are, even though we will inevitably continue to describe them, and try to make sense of them, in the framework of our own.

Using This Book

The entries in this encyclopedia fall into three categories. First, there are those that elaborate upon some of the key *themes and issues* relating to ancient astronomy, many of which have been introduced above. They include, for example, LUNAR AND LUNI-SOLAR CALENDARS, PALAEOSCIENCE, and ASTRONOMICAL DATING. Other entries in this category relate to particular objects or phenomena in the sky and their cultural significance (for example, ORION and LUNAR ECLIPSES). Also included are broad definitions and explanations of key concepts (such as ARCHAEOASTRONOMY, COSMOLOGY, and ALIGNMENT STUDIES), brief descriptions of procedures and techniques (for example, FIELD SURVEY and STATISTICAL ANALYSIS), and a few people who have been important in the overall development of the subject, such as SIR NORMAN LOCKYER and ALEXANDER THOM. The second category comprises *case studies* of a variety of types of human society, from hunter-gatherer groups to urban city-states, and spanning a chronological and geographical range that stretches from Upper Palaeolithic Europe through Polynesia and other remote parts of the world prior to European contact. Though the case studies are far from exhaustive, they have been carefully selected to illustrate particular issues and themes, with an emphasis upon cultures and places that are less well known outside the specialist literature of archaeoastronomy. The final category of entries consists of short, nontechnical explanations of *basic concepts* like SOLSTICES, HELIACAL RISE, and DECLINATION. At the end of each entry is a list of related entries divided into three parts: themes, case studies, and basic concepts. Straightforward definitions of terms are given in the glossary.

We have avoided drawing sharp divisions between *ancient* and *modern*—divisions that only serve to mask the rich variety of human ways of understanding and appreciating the sky. For this reason, we include topics such as CHURCH ORIENTATIONS and ASTROLOGY, which extend into relatively recent and even modern times, together with examples of traditions that live on still among modern indigenous peoples, such as BARASANA "CATERPILLAR JAGUAR" CONSTELLATION, MURSI CALENDAR, and PAWNEE COSMOLOGY.

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A

Aboriginal Astronomy

When Captain James Cook first sailed up the east coast of New Holland (what is now Australia) in 1770, he encountered native people who had little interest in their strange visitors and none whatsoever in trading—people who surprised him by being generally unclothed, constructing little in the way of shelter around their camp fires, and even sleeping in the open. Yet their lifestyle, while short of so many of the conveniences viewed by Europeans as essential, also seemed free from many of the cares that accompanied them. As Cook saw it, the earth and sea satisfied all their needs.

As we now know, the Aboriginal way of life had gradually developed over many thousands, and indeed tens of thousands, of years. Australia's first inhabitants traveled to the continent more than 50,000 years ago from Asia, via the islands of what is now Indonesia. Despite lower sea levels at that time, the journey still involved crossing straits as wide as eighty kilometers (fifty miles) or more. During the long history of the Aboriginal peoples, factors such as climate change almost certainly caused significant upheavals, but by the time the Europeans arrived, Aboriginal groups were to be found in all corners of this vast and largely arid continent. Their lifestyle had become well adapted to an environment that, from a European perspective, was immensely inhospitable. Never settling for long in one place, they lived by gathering food, hunting, and (for people in the coastal fringes) fishing. This hunter-gatherer style of subsistence had never been superseded by agriculture, let alone affected by technological innovation such as metallurgy.

Since Aboriginal culture and tradition had developed independently of the rest of the world for millennia, it is tragic that much of it was utterly destroyed in such a short time after the arrival of the Europeans. It is estimated that at the time of contact there were more than 750 different Aboriginal languages, few of which now survive. Though our knowledge of the ways in which different native Australians viewed the world in pre-contact times is extremely fragmentary, there was clearly considerable diversity between different groups. Yet it is evident that certain fundamental concepts and

Aboriginal engraving at America Track, Kuringai Chase National Park, New South Wales, showing the head and neck of the culture hero Daramulan. (Courtesy of Clive Ruggles)

principles underlay most Aboriginal systems of thought. The most important of these is the *Dreamtime* or *Dreaming*. The Dreamtime is sometimes portrayed as a sort of parallel, more fundamental reality in which ancestor spirits created the world and continue to exist within it. Certain places and paths through the landscape have deep significance within the Dreamtime. The actions of ancestors are re-enacted in many aspects of life, and oftentimes these re-enactments involve being at certain places and following certain paths.

Aboriginal peoples identified strongly with the landscape. Some of the places charged with sacred power were natural, such as distinctive rocks, termite mounds, or water-holes. Others were created, such as "ringed" eucalyptus trees (branches growing apart were trained together again until they rejoined, forming a ring in the trunk). In some locations, "stone configurations"—constructed arrangements of rocks and boulders—also appear to mark sacred places in the landscape, especially in regions devoid of other prominent natural landmarks.

However, to see the Dreaming as something in the Aboriginal mind that is superimposed upon the physical world is a quintessentially Western view of things. From an Aboriginal perspective, the motions and actions of the ancestors are an integral part of the world and can be perceived in places, in the objects that are found there, in the pathways between them, and in events that are constantly happening ("signs," which must be perpetually