Although we have suspected there is something astronomical about Stonehenge for over two hundred years, the ruins seemed unique until Alexander Thom revealed the geometrical and astronomical complexity of the many other Megalithic sites. It comes now as an even greater surprise to us in the United States that not all ancient astronomical sites are in distant lands. Some are as close as the American Midwest and the Rocky Mountains. Dr. John A. Eddy, senior staff member at the High Altitude Observatory in Boulder, Colorado, tells here, for the first time, the whole story of archaeoastronomy in North America.

We are much closer in time to the cliff dwellers of the Southwest, the mound builders of the Mississippi Valley, and the nomadic peoples of the Great Plains than we are to the builders of Stonehenge, but, as John Eddy shows, we encounter the same major problem as we did with the Megalith Builders: the American Indians left us no written record to tell us what kind of astronomy they did. It is necessary, therefore, to rely on careful surveys of remaining sites and structures. Without these there would be no evidence at all.

Eddy is particularly well qualified to evaluate the North American evidence. He is a solar physicist, but he has also authored papers on a variety of historical aspects of astronomy, including Thomas Edison's
contribution to infrared astronomy and, more recently, the Maunder minimum in solar activity. Most importantly, Eddy surveyed the Big Horn Medicine Wheel in Wyoming and demonstrated its astronomical importance in a paper which was featured on the cover of Science. Discovery of this “American Stonehenge,” as news reports dubbed it, has re-emphasized how important a role astronomy may play in many ancient cultures.

Eddy’s first-rate work on the Big Horn Medicine Wheel maintained the high standards already set by Professor Thom in Europe. Several other medicine wheels and related structures have since been surveyed by Eddy, and they agree with his original interpretation. He is especially aware of the pitfalls of archaeoastronomical research and reports in this chapter what is and isn’t yet known about the astronomy of the North American Indians.

THE INDIAN AND THE SKY

It is said that when the first Europeans came to the North American continent and in time were able to converse with Algonkian tribes, they pointed to the familiar pattern of seven stars in the northern sky and said, “Those stars are what we call ‘the Bear.’” The Indians, so the story goes, replied, “Yes, we call them ‘the Bear’ too.”

It is hard for anyone to find a bear or any part of a bear in the seven stars of the Big Dipper; the European basis for calling them a bear, Ursa Major, is lost in dim origins of prehistory. And so the Indians’ reply poses an interesting riddle: why would two cultures which had developed separately in isolated halves of the world give the same unlikely name to a pattern of seven stars in the northern sky?

A romantic and intriguing answer is that in this innocent exchange European and Indian revealed their common ancestry, that the unlikely association of this star pattern with a bear had its origin in the murky thoughts and traditions of primitive people on a distant continent, and that these traditions were preserved and carried in opposite directions by diverging peoples over tens of thousands of generations, westward into Europe and eastward to Asia, up across the Bering Strait and down, to meet again in chance conversation on the shores of newly found America.

But an answer equally good is that the name was chosen independently for natural and logical reasons: in the northern hemisphere the north is cold and bears are hardy animals. The circling of the con-
stellation around the celestial pole resembles the restless prowling of a bear around his den. Alternatively, of course, the choice of the same name by isolated peoples could have been a coincidence of pure chance.

Whatever the answer, and whether or not the story related at the beginning of this chapter is true at all, by entertaining the question we accept the belief that the American Indians were interested in the sky. I do not think that many would doubt this or question that an interest and knowledge of things astronomical were practical and important parts of North American Indian life. We find the stars and the sky woven through their legends, their symbols, and the basic fabric of their practical religion, in which the sun was principal deity.

In admitting that the Indians measured the passage of time in "moons," we acknowledge that they were practiced observers of lunar phases. Since they spent more time than we in looking at the night sky (and under far better conditions), we may assume that they knew the star patterns better than most of us do today. We may equally well assume that a part of their natural lore was a familiarity with the changing path of the sun against the star background and that an important part of this practical knowledge was an awareness of the summer and winter turning points of the sun's place of rise and set. It is natural that the Indians would associate the sun's approach to the one turning point, in summer, with light and warmth and a bountiful earth, and the approach to the other, in winter, with cold and darkness and barren land. We know that they designed rituals to celebrate the solstices—the one a time of rejoicing and the other a time to strengthen the weakened sun for its long journey northward. These truths are self-evident. They follow logically and naturally in the lives of any people who live by the sun, out of doors, whose whole existence is dominated by the seasons, and who watch for dawn from rude beds on the hard ground. We hardly need any archaeological evidence to establish whether or not the American Indian had a practical astronomy and an intimate knowledge of the sky, although, in fact, there are abundant signs scattered over the continent in the form of rock paintings and rock carvings, in celestially aligned mounds and other structural relics, and in stone patterns laid out on hills and mountain tops.

Curiously, we do not read much of the Indians' astronomy in the first-hand accounts of their existence made by observers in the final centuries of the Indians' natural life on the continent. We find tales and legends of the sky in a mythological sense but descriptions of practical use of the sky are virtually absent from the depositions taken from Indian descendants in this century and the last. We do know that the Pueblo Indians designated tribal officers to identify the times of sol-
stice. They did this into modern times by setting up horizon markers for sunrise and sunset. But this is almost the entirety of the first-hand, direct evidence of the North American Indians' practical interest in the sky. The Plains Indians did not know, or admit knowing, either the origin or the obvious astronomical alignment of the rock patterns that are found in their lands. Those who were still using the Mississippian mounds when Europeans came told or knew little about the details of their construction and plan.

The absence of astronomical reference in depositions and first-hand accounts is more than anything an indication of the limitations of this technique in ethnology. In first-hand observation and depositions, we take a real sample of only the last 1 or 2 per cent of the time of residence of the Indian in America and make further deductions only by hearsay and supposition. Moreover, in the sampling process we may influence the answers. It is much like the uncertainty principle of quantum mechanics: the act of making a measurement influences the outcome. In the anthropological application, the act of inquiring affects the answers given; moreover, the time required to learn to communicate with the Indians allowed their ways to shift and change. They were quick to adopt the ways of the white man, especially as they appeared better or easier than the Indians'. The bow was readily dropped for the rifle, and earthen cooking pots were abandoned when metal kettles could be had. In but a generation or two natural skills and practices, such as telling time and season by the stars, could be lost and forgotten through replacement by easier, newer ways. I cannot harness a workhorse nor hitch a team to a wagon, yet to my grandfather these were acts of second nature. So in a generation or two at a time of revolutionary change in Indian life, much practical lore could have been lost.

Depositions are further suspect, for the Indians were often inclined to give the answers sought—to create the mythical seven lost Cities of Cibola of the American Southwest and direct the seekers there—if that was what was asked. In this trait we find another possible answer to the riddle of the Ursa Major stars: acculturation by emulation. The Indian called them "the Bear" because the white man had.

Unfortunately we cannot get to the truths of the North American Indians' use of astronomy through written evidence, for they had no written language. Yet the many marks and lines left on cliffs and walls and hilltops are an objective language of deeds, which can be read as evidence that is probably more eloquent and compelling than spoken words or repeated tales, however sincerely told.
A. Possible Records of the Crab Supernova

If we search the sky near the tips of the horns of the celestial bull, Taurus, we will find, with the aid of a telescope, a nebula of great beauty called “the Crab.” It is an object of prime astrophysical interest, for it is believed to be the remnant of a catastrophic explosion of a star, a supernova outburst. From present-day measurements of the expansion rate of the nebula, astronomers calculate that the supernova explosion should have been observed in Taurus about nine hundred years ago, in the middle of the eleventh century, about the time of the First Crusade in Europe. The supernova would have appeared as a new star of extraordinary brilliance.

In fact, Chinese records of the Sung dynasty indicate that a bright object was observed in Taurus in A.D. 1054. It was recorded in the Chinese annals as a new star, or “guest star,” and was first seen on July 5 or 6. It was bright enough to be seen in the daytime for about three weeks, and it then slowly faded in brilliance. At its first appearance it was probably the brightest object, other than the sun and moon, ever seen in the sky in the record of humanity. At its brightest, it was about five times brighter than any of the planets we see in the night sky today.

Other peoples on the earth should have seen the bright new star and recognized it as something unusual, if they were regular watchers of the sky. If the American Indians saw and recorded it in 1054, it would indicate that they knew the sky well enough to recognize a new feature in it.

In 1955 two unusual Indian pictographs were found in northern Arizona, in the course of archaeological fieldwork. Though they were found many miles apart, the two drawings showed a similar design: a crescent moon near a solid circle. One, a painted pictograph, was found on the wall of a cave. The other, a petroglyph (carved in stone), was on a canyon wall. They were considered unusual because the crescent was not believed to be common in Southwest Indian rock art.

William C. Miller, a distinguished astronomical photographer at Mt. Wilson/Palomar (now Hale) Observatories, became interested in the drawings, on the supposition that they might represent a real astronomical event. Might they portray Amerindian observations of the brightest object, other than the sun and moon, ever seen in the sky, the supernova explosion in Taurus of A.D. 1054?
To help answer the question, Miller needed to know whether or not the bright new star seen by the Chinese was near the moon in the sky at the time of its discovery. If it was, if the moon was in crescent phase at the time, and if the sites were occupied in A.D. 1054, then the association would seem plausible. These three questions were not hard for astronomy and archaeology to answer. Calculations showed that the supernova should have appeared very near the moon on the morning of July 5, 1054, as seen from western North America and that the moon was in crescent phase. Moreover, the moon appeared above the star in the sky, as shown in both of the Arizona drawings. Archaeologists verified that the two sites were indeed occupied at that time, in the middle of the eleventh century. The case, albeit circumstantial, seemed strong that in at least two neighboring locations in the American Southwest, Indians saw the bright new star near the moon and recorded it on the walls of canyon and cave. If true, it would indicate that these early Americans knew the sky well enough to recognize a newcomer in the field of stars and that, in a limited sense, they knew the sky as well as the more culturally advanced Chinese astronomers.

This is an interesting and important point, and since the time that Miller published his finds a number of other American scientists have pursued the problem further, carrying out more details of the calculations of star and moon positions and searching for other examples of the possible portrayal of the event by early American Indians. These scientists, all astronomers, who have pooled their work on the problem, are John C. Brandt and Stephen Maran at the NASA Goddard Space Flight Center, Greenbelt, Maryland; Ray Williamson of St. John's College, Annapolis, Maryland; Robert Harrington of the U. S. Naval Observatory, Washington, D.C.; and Von Del Chamberlain of the National Air and Space Museum, Washington, D.C. Others who worked on the problem were Muriel and William J. Kennedy of Pacific Grove, California, and Ranger Clarion Cochran of the Chaco Canyon and Aztec Ruins National Monuments in New Mexico. Together they have found and examined a significant number of additional examples of unusual pictographs and petroglyphs which portray a conjunction of a crescent moon with a starlike object. Each of these depictions is found at a site which in all probability was occupied at the time of the supernova appearance, and each is in the vicinity of a clear view of the eastern sky, where the moon and star appeared near the horizon, before dawn on July 5, 1054. Brandt and his colleagues have determined that the conjunction between the crescent moon and the supernova was closest for observers in the western part of the North American continent, which adds to its importance there, strengthening the case that
The crescent moon was visible in western North America near the Crab supernova in the predawn eastern sky on July 5, A.D. 1054. (John A. Eddy)

Several examples of crescents in rock art from the American Southwest are associated with what may be representations of the A.D. 1054 supernova. (John A. Eddy)

below: Pictographs & Petroglyphs, from sites occupied in the 11th Century

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Chaco Canyon, New Mexico
Northern Arizona
Northern Arizona

Fern Cave, California
Symbol Bridge, California
Abo Monument, New Mexico
the spectacle might have been remembered and recorded. By the time that the moon rose in China on the early morning of the conjunction, the separation between moon and star had increased to about 6 degrees—three times the distance when it appeared to the inhabitants of America.

In attempting to decipher astronomical signs and messages in the Indian pictographs and petroglyphs, astronomers and archaeologists are employing techniques similar to those used by Alexander Marshack on the drawings and relics of Ice Age peoples in Europe. In each case we deal with a partially translated language of symbols. In each case there are genuine and serious doubts whether the interpretation is accurate in detail or in general. And in each case reliance, in the end, must be put on the number of cases that are found which seem to fit a certain interpretation. Doubts will always remain. The numerous added examples of possible pictures of the 1054 supernova have strengthened the original case made by Miller, but Brandt and his colleagues are quick to point out that they can never prove that the rock art records refer, in fact, to that particular object in the sky.

Professor Emeritus Florence Ellis of the Anthropology Department of the University of New Mexico is one who doubts the association of these markings with the supernova event. From her knowledge of present customs of the Pueblo Indians in the area, it seems unlikely to her that any unusual sky event would have been recorded, even if it had been seen and recognized as something special. Moreover, she feels that the crescent symbol was not uncommon and that it was used to represent the sun, Venus, or the new moon in connection with the Indians' way of counting time by lunar phases. Professor Ellis feels that the crescent and star symbols probably identified sites from which sunrise was watched to mark the time of solstice. Sun symbols are found near some of the crescent and star markings which have been cited by Brandt and his colleagues.

B. Astronomical Interpretation of Other Symbols

Von Del Chamberlain, one of the investigators of the possible depiction of the 1054 event, has pointed out in other work that we are still ignorant of what symbols the Indian may have used for many possible astronomical objects. A rayed-disk symbol for the sun is common in Indian pictography and is well recognized. But how, for example, might the eclipsed sun have been shown? If the Indians recorded the bright supernova, they would likely have recorded the unusual spectacle of a total solar eclipse. Such an event might well have worked its way into lore, ceremony, and rock art depictions. If such a record could be found, it would provide the possibility of rather precise dating. As
evidence that eclipses were noted and recorded, at least in modern
times, Chamberlain cites a possible depiction of a solar eclipse in a pic-
tographic diary, or “winter count,” of the Dakota tribe for the year
1869–70. A total solar eclipse was visible in their lands on August 7,
1869. Chamberlain suggests that in rock art some pairs of circles, one
circumscribed in the other, may be the representation of the eclipsed
sun.

Stars and star patterns were recorded by Indians in a number of ways
which have been described by Chamberlain. The most common, per-
haps, is a four-pointed star or cross, sometimes with circumscribed cir-
cle. Stars might also be shown as small circles and as dots and rayed
points. There are many known examples of patterns representing stars
and perhaps even constellations carved, pecked, or painted on rocks and
on the ceilings of caves and other structures. Stars, asterisms, and con-
stellations appear often in Navajo sand paintings.

Claude Britt, Jr., of Round Rock Trading Post, Chinle, Arizona, has
recently described a great number of Navajo “star maps,” or star ceil-
ings, which are found in the Canyon de Chelly ruins in Arizona.

Chamberlain has also cited the Indian’s interest in meteors, fireballs,
and meteorites, which confirms that the Indian observed and thought
about “falling stars.” A legend of the Menomini Indians of the Great
Lakes area, cited by Chamberlain, reveals that an association was made
between “shooting stars” and iron meteorite fragments found on the
ground:

When a star falls from the sky
It leaves a fiery trail.
It does not die.
Its shade goes back to its own place to shine again.
The Indians sometimes find the small stars
where they have fallen in the grass.

He points out that a number of iron and stony meteorites have been
found in Indian ruins and burial mounds, in places and circumstances
which indicate that they were considered to be of especial importance
or worth.

ASTRONOMICAL ORIENTATIONS OF ANASAZI
STRUCTURES

The Anasazi were prehistoric basket makers and cliff dwellers whose
civilization thrived in the Four Corners region of the American South-
west beginning nearly two thousand years ago. They are known to most
of us as the builders of elaborate celled communal dwellings, under-
ground circular kivas, and cliff houses. They are the same people who were mentioned in the preceding section as having possibly depicted the supernova explosion of 1054. The Anasazi were the ancestors of the present-day Pueblo Indians of New Mexico and Arizona, some of whom, as at the Taos Pueblo, still live in similar structures and follow a similar way of life.

Some modern Pueblo Indians continue to use the rising and setting points of the sun at solstice to mark their year and its festivals. We may suppose, therefore, that their ancestors put astronomy to use in much the same way, and we would expect to find evidence of solstitial alignments and possibly other celestial alignments in some features of the Anasazi architecture. In addition, the regular lines, angles, and occasional symmetry of some of the ruins suggest that some form of rudimentary surveying was used in their construction, and celestially determined directions are a possibility. Curiously, in spite of numerous claims and frequent interest in the area, as yet almost nothing has been published and verified concerning such alignments. This unfortunate situation probably reflects the frequent doubts about whether certain structures were rebuilt in early excavation, about the lack of workers in the field, and perhaps about the almost overwhelming extent and diversity of the Anasazi ruins.

A. The Mesa Verde Sun Temple

Long suspected of astronomical orientation is the so-called Sun Temple, an enigmatic structure of mortared stone found atop a cliff in Mesa Verde, in the southwest corner of Colorado. It was first investigated by J. W. Fewkes, of the Smithsonian Bureau of American Ethnology, who found it through excavation in 1915.

Fewkes called the ruin a “temple” chiefly because its architecture and layout were unlike the Mesa Verde structures which were known to have been used for habitation and because, he felt, it was the work of a community effort. The adjective “sun” came from Fewkes’s interpretation of a small pattern which looked like a rayed sun or the symbol for the sun and which he found etched in one of the stones at the exterior, southwest corner of the structure. (The “sun symbol” is now known to be a fossil imprint of a leaf.)

The Sun Temple is unusual in location and shape. Most of the associated Mesa Verde structures are in protected and inaccessible locations in cliff walls. The Sun Temple sits in an exposed location atop and near the edge of a mesa. This gives it an imposing appearance and the possibility of clear astronomical horizons.

The Sun Temple is a many-chambered structure which has the overall shape of a capital letter D. Fewkes measured the back of the D to be
In 1915 J. W. Fewkes claimed that the straight wall of the Sun Temple at Mesa Verde National Park, Colorado, at the bottom of this 1916 sketch, was aligned with the summer solstice sunrise. A small fossil pattern resembling a sun symbol was found in stone at the lower left corner. (J. W. Fewkes, from *Art and Archaeology*, vol. 3 [1916], p. 341)

about 120 feet long and about 12 feet high at the highest point. From the pile of stone rubble in and around it, he surmised that the structure may have originally stood 18 feet high. Fewkes capped the walls with mortar, for preservation, and some believe that he may have rebuilt part of them—a point which is not answered by his available excavation notes.

Fewkes suspected that the straight side of the D was astronomically oriented to the rising point of the sun at summer solstice (and therefore to the setting point at winter solstice). Apparently he felt he had confirmed this through observation of the rising of the sun at the equinox (which defined the eastern point of the horizon) and by estimating the angle between the place of sunrise (east) and the real wall angle. He apparently did not determine the wall orientation with compass or transit, and, so far as we know, he did not make sunrise observations at either of the solstices.

One of those who in subsequent years had something to say about the astronomical alignment of the Sun Temple was L. J. Robinson of El Camino College in Torrance, California. Robinson claimed in 1955 that the straight wall of the D was aligned to the equinoctial rising points of the sun, that is, exactly east-west. This is practically the opposite of Fewkes's study, but it is not clear whether Robinson was aware of Fewkes's contradictory finding. Robinson also pointed out that there were coaligned holes in the interior walls of the structure, particularly
along the straight side of the D, which were likely sighting ports and which would therefore have improved the precision of the building's original alignment. If the structure were really aligned to the equinox points, it would imply, of course, a rather sophisticated surveying method, for the east-west points are not nearly so easy to identify as the extremes of summer and winter solstice.

A subsequent and more thorough investigation was made by J. E. Reyman, an anthropologist at Southern Illinois University, and described in his dissertation in 1971. With a transit, Reyman determined that the tangent to the straight wall of the D was within 0.5 degree of the summer solstice sunrise/winter solstice sunset direction, apparently verifying Fewkes's original claim. Later, however, Reyman observed sunset at winter solstice at the site and found that the wall was not so aligned. He attributed the difference to possible error in the earlier transit measurements cited in his dissertation. This would seem to cast doubt on other possible astronomical alignments of the Mesa Verde Sun Temple which Reyman had mentioned in his dissertation. Among these were possible auxiliary markers for sunrise, midday, and sunset at the equinoxes and possible alignments on unspecified parts of the path of the moon. The clearest summary at this point seems to be that the alignment of the Mesa Verde Sun Temple is as yet unknown, or at least unpublished, after sixty years and a number of conflicting claims.

B. Other Mesa Verde Sites

Reyman also described a number of other possible astronomical associations at Mesa Verde. Included were wall alignments, window alignments, a large body of data on kiva alignments, and descriptions of wall markings which may have been astronomically inspired. Several of the proposed alignments are for rising and setting azimuths of Venus. Since the declination of Venus swings through nearly 65 degrees, the apparent alignment of any structure on its place of horizon crossing at one arbitrary date is probably no more than chance. Venus, the most brilliant of all the planets and stars, surely captured the attention of all primitive sky watchers. But any who noted its place of rising or setting for more than a night or two would have detected its shifting pattern which oscillates about the sun. Likely to be marked or noted would have been its places of heliacal rising or setting, when the planet would appear only momentarily at dawn or dusk, but these do not recur at simple fixed azimuths for the observer at any one place. Dedicated primitive astronomers might have marked the extreme azimuths of its rising and setting, which follow long-term cyclic patterns like the extrema of the moon. No evidence for this sort of sophistication has been found north of Mexico.
Reyman did find an interesting star pattern pecked in the ceiling above a north-facing window in the square tower of the Cliff Palace ruin. The pattern—seven dots which resemble a dipper—may represent the Little Dipper, or Ursa Minor, which was visible through the window. This association is based upon a simple window view, without definite fore- and backsight markers and hence is far from precise, as Reyman warned. The association, if real, would not be surprising. We can imagine that a familiar star pattern, seen out a window, might inspire one to copy it on a surface within reach. And although the stars of the Little Dipper are faint (about five times fainter, on the average, than those of the Big Dipper) its association with Polaris, the polestar, has made the Little Dipper one of the best known of all star groups. We should probably be surprised if it weren’t recorded in some way by almost all primitive peoples.

C. Alignments at Chaco Canyon and Other Southwest Sites
Also investigated by Reyman and described in his dissertation are possible astronomical associations at the Aztec Ruins, Chaco Canyon, the Village of the Great Kivas, Gran Quivira, and several other Anasazi ruins in New Mexico and Colorado. For these sites, including Mesa Verde, he proposes possible star alignments for at least eighty-eight different kivas, great kivas, walls, towers, and other structures. The reality of the great majority of the associations is subject to considerable doubt. Most alignments are on dim stars which cannot be seen within several degrees of the horizon. Of the eighty-eight star associations, all but ten are on objects of magnitude two or dimmer and only three are from the ten brightest and most likely to be marked stars. Many of the proposed alignments are on circumpolar stars. These are very unlikely, for they never cross the horizon. Reyman has concluded that kivas show preferred directional orientations which are probably not astronomical, but architectural, for example, to provide good ventilation.

At Chaco Canyon in New Mexico Reyman found possible solstitial alignments in two major structures, Casa Rinconada and Pueblo Bonito. Casa Rinconada is a circular, walled structure with T-shaped doors and scattered wall niches. Like most other structures in Chaco Canyon, Casa Rinconada is built of dressed-stone bricks in thick walls which are laid with impressive precision and regular pattern. It is one of the so-called great kivas, which like the smaller ones were probably built for religious or ritualistic use. It lies partially sunken in the ground, in a broad, shallow valley between low, surrounding mesas which provide slightly elevated local horizons.

Reyman has proposed that the solstice sunrise and sunset points might have been marked at Casa Rinconada by foresights on the sur-
rounding mesa top, for which he proposes signal fires. He assumed that the backsight was at some point in the kiva, perhaps the center of the structure. In searching the surrounding mesa top, Reyman found fire-burned areas in the directions of winter solstice sunrise and winter solstice sunset. Pottery found at these fire-burned areas was of a type contemporaneous with Casa Rinconada (c. A.D. 1100). No certain areas were found at the corresponding points of summer solstice. Other burned areas were found on the mesa top, but these were not considered. They did not fall on astronomical alignments.

Pueblo Bonito is probably the best known of the structures at Chaco Canyon. It is the well-preserved ruin of a large, D-shaped, multistoried communal dwelling which was occupied at about the same time as Casa Rinconada. Reyman has found two corner windows in remaining third-story rooms of Pueblo Bonito which appear to be aligned with the direction of sunrise at winter solstice. The precision of the alignments is not specified, and the base lines over which the alignments are proposed are only the thickness of the window jambs, that is, the thickness of the wall of the structure. Since the accuracy of any alignment depends upon the distance between foresight and backsight, the usefulness of a short base-line alignment, such as the one proposed, would be extremely limited. Furthermore, the possibility of chance alignment is high, for there were in Pueblo Bonito rooms and windows to accommodate five hundred to one thousand persons. Moreover, as Reyman points out, it is not certain that the two windows had unobstructed views at the time that the entire structure stood.

At Chetro Ketl, another major structure in Chaco Canyon, Reyman found wall alignments which were within 2 to 3 degrees of the direction of summer solstice sunrise (and winter solstice sunset). He considered these to be doubtful because of the possible effects of (modern day) reconstructions of the walls. Indeed, the persistent doubts of change in reconstruction haunt many of the proposed Anasazi alignments. These same problems plague analysis of the Sun Temple at Mesa Verde, and the archaeoastronomy of the American Southwest is still ambiguous.

Other scientists have looked into the possible alignments of the major structures at Chaco Canyon. In a recent report, R. A. Williamson, H. J. Fisher, and A. F. Williamson of St. John’s College and Ranger Clarion Cochran of the Aztec Ruins and Chaco Canyon National Monuments reported surveying data which indicate astronomical alignments of three great kivas, although their findings differed from those made by Reyman. On the surrounding mesa tops they found directional markings cut into the rocks which were aligned with the direction of sunrise at winter solstice.
The remarkable Chaco Canyon ruins offer an almost irresistible temptation to amateur scientific speculation, and a number of claims have been made offering elaborate astronomical explanations for many features and structures. Some have noted intricate patterns of cross-kiva alignments by which rays of celestial objects illuminate specific wall niches of the great kivas at unique astronomical times; these purported alignments are then taken to indicate that the Anasazi Pueblo people at Chaco had advanced computational abilities and methods of predicting eclipses. There may be truth in some of these conjectures, but none has been presented quantitatively for astronomical verification, and none has been considered plausible by professional archaeologists who are familiar with other known aspects of the Chaco ruins, including the crucial matter of the known sequence of construction, use, and reconstruction of the buildings.

**QUESTIONS OF THE EARTHEN MOUNDS**

Best known of the structures left behind by the early inhabitants of eastern North America are the earth mounds, which are found chiefly in the valleys of the Mississippi and its tributaries. Many have been destroyed, but the known examples still number in the thousands. They differ significantly in size, form, era of construction, and, very probably, in use. Some are no bigger than a grave; others are a hundred feet high and many acres in extent. Some are geometrically regular and precise; others are simple heaps. Many were built as burial structures; others were probably not.

Serious investigations of the American mounds have destroyed the once-popular myth of a mysterious race of so-called Mound Builders, and modern archaeology attributes them to various groups of early-day agricultural and pottery-making Indians. The mounds were built, we now understand, by three successive groups or cultures starting perhaps three thousand years ago. The first, known as the Adena culture, left burial mounds in present-day Ohio, Indiana, Kentucky, West Virginia, and Pennsylvania. They also built more elaborate and more poorly understood mounds, including many in the shapes of reptiles, birds, and other animals. The best known of these is the Great Serpent Mound in Adams County, Ohio.

A later culture, the Hopewell, overlapped and then supplanted the Adena culture several hundred years before Christ. The Hopewell people continued to build mounds, chiefly in Ohio, Illinois, and through the Mississippi Valley. Some of the Hopewell mounds were elaborate burial mounds; others were impressive geometrical structures—perfect
circles, squares, octagons, and straight lines. A good example is found in
the well-known earthworks at Newark, Ohio, where an octagonal pat-
tern, several acres in extent, is connected by a causeway to a circle of
similar size.

Last, a culture known as Mississippian constructed massive platform
mounds, frequently pyramidal in form, through the Mississippi Valley
and adjoining regions of the present-day southern states. Some of the
mounds were surmounted with buildings, dwellings, and temples of
wood and thatch. The most elaborate and extensive of the temple
mound sites was the small-city complex that was later called Cahokia,
near Collinsville, Illinois, a few miles from East St. Louis. The Missis-
sippian culture flourished from about A.D. 1000. Some of the North
American Indians were still using platform mounds when European
explorers first explored the continent in the sixteenth century.

There are good reasons to suspect that some of the mounds, in some
or all mound-building eras, were associated with the sky, in orientation
or purpose. Probably, too, the pyramid builders of Mesoamerica and the
North American builders of the temple mounds were in contact, for
some of the Mississippian mounds bear striking resemblances to Meso-
americian pyramids. There are evidences other than architectural similari-
ties for this contact, and it is commonly proposed, if not accepted, that
mound building in North America received at least some of its impetus
from peoples to the south. As evidence grows for astronomical uses of
certain of the Mesoamerican pyramids and platforms, so, by association,
does suspicion grow that similar uses may have been built into some of
the North American mounds.

Other bases for suspecting astronomical associations in the mounds
are quite independent of Mesoamerican contacts. The regular and sym-
metric forms of some of the Hopewell mounds suggest sky alignments.
The mound builders were an organized, agricultural people with need
of a calendar reference. Finally, some of the effigy mounds represent
figures which have counterparts in the Indians’ panoply of constell-
ations.

In discussing possible astronomical associations of the American
mounds, we are in an area of almost complete conjecture. Little organ-
ized fieldwork has been done. Very few claims have been made for any
specific associations. Even less has been published in the scientific liter-
ature. This is, however, an area where thorough and objective inquiry is
deue. Careful, documented measurements and skeptical interpretations,
with the help of those who are professionally expert in the mounds and
their known history, are badly needed. Proper tests for astronomical
alignments and associations could add new information to the matter
of possible Mesoamerican contact. If found, astronomical orientations
would give insight into the level of culture of the builders of the mounds and, in certain cases, could provide an independent check on construction dates.

A. Mounds as Symbols of the Constellations
In recent work psychologist Thaddeus Cowan of Kansas State University has proposed that some of the conical mounds were built to represent individual stars, sometimes grouped in star patterns, and that certain of the effigy mounds represent constellations. The religion of the mound-building Indians centered on sky deities, and there are apparent connections between Indian sky legends and features of some of the mounds. The mounds were large and were sometimes built on hilltops, as though directed at the sky.

Cowan proposes that the Great Serpent Mound in Ohio is a representation of the Little Dipper (Ursa Minor, or Little Bear) and the polestar and that other bird and bear effigy mounds represent the Big Dipper (Ursa Major, or Great Bear) and the Northern Cross (Cygnus, or the Swan).

The physical similarities are subtle, and the associations proposed seem far from certain. The Great Serpent Mound is a long, twisting hill, about 20 feet wide, 4 or 5 feet high, and ¼ mile long. It looks very much like a snake with a coiled tail and with a round object, perhaps taken as an egg, in its mouth. Cowan regards the overall curve of the twisting serpent as the handle and top two bowl stars of the Little Dipper; there is nothing in the mound which matches the Little Dipper’s complete bowl, which, significantly, is brighter and more conspicuous than the handle. For the serpent to match the curvature of the handle of the Little Dipper, Cowan puts the polestar in the coiled tail. He points out that the direction of coil—a clockwise spiral—is the same as the apparent direction of diurnal rotation of the Little Dipper about the north pole. In addition, he cites a purported connection, in the symbolism of Indians of the Ohio region, between a serpent and the swastika—a common symbol which signifies rotation. Cowan does not claim perfect matching between any of the effigy mounds and precise star patterns but bases his case largely on interpretations of symbolism, legend, and lore. Another large serpent mound, in Otonabee Township, Ontario, Canada, has an oval shape near its head, but its tail does not coil into a spiral. This second snake does not confirm the astronomical association.

B. The Newark Earthworks
The remains of the remarkable Newark Works, in central Ohio, are striking examples of Hopewell geometrical mounds and obvious candi-
Thaddeus Cowan argues that the Great Serpent Mound in Ohio is a representation of the Little Dipper. (John A. Eddy)

dates for tests of possible astronomical orientation. The original complex, as found by early European explorers and settlers, covered about four square miles. Remaining today are the outlines of two circles and an octagon, traced out in broad and rounded earthen walls, from 5 to 15 feet high. One of the circles, about 1,200 feet in diameter, is connected to the octagon by a parallel causeway which is outlined in the same way. Together the circle and octagon cover about seventy acres, which fortunately are protected by the city of Newark as a park and golf course. I have found by simple map examination that a line through the axis of symmetry of the octagon, the center line of the causeway, and the center of the connected circle coincides very nearly with the direction of northernmost rise of the moon at the latitude of Newark. This extreme point of moonrise, which Alexander Thom calls the northern major lunar standstill and which he finds marked in many European Megalithic monuments, is reached in cycles of 18.61 years. Other investigators have found possible alignments at Newark on the
The connected circle and octagon at the upper left of this 1848 map of the earthen mounds at Newark, Ohio, cover an area of about seventy acres and are preserved today. The axis of symmetry of circle and octagon, by map measurement, coincides with the major standstill northern moonrise, an extreme reached every 18.61 years. (John A. Eddy)
rising of the summer solstice sun, but nothing has been published in the scientific literature.

C. A Possible Woodhenge at the Cahokia Mound Site
The most elaborate of the known Mississippian mound-builder sites is Cahokia, near East St. Louis. At one time thousands of people lived there, in an elaborate and organized city, built around ceremonial centers of high, pyramidal earthen mounds. A central group, of over one hundred mounds, was occupied in the period between about A.D. 800 and 1550.

About eighty of the Cahokia mounds survive today. The largest, Monks Mound, is the largest Indian mound in America north of Mexico, and the largest prehistoric earthwork in the world. It is built on a base that covers sixteen acres and rises in four steps to a height of about 100 feet.

In archaeological work in the early 1960s, Warren Wittry of the Cranbrook Institute of Science, near Detroit, found evidence of four large posthole circles in an area that lies about one half mile west from Monks Mound. One of these circles he interpreted as a “woodhenge” (or circle of wood posts) which could have been used to mark the directions of sunrise at summer and winter solstice and at the equinoxes.

Only about half of this circle of postholes was found. From it, however, Wittry determined that it was part of a precisely drawn circle, about 410 feet in diameter, and that the full circle most likely consisted of forty-eight holes or pits (twenty of which were found). Each pit was about 2 feet wide, 4 feet deep, and elongated in one dimension to about 7 feet. Wittry concluded that the pits were this shape to ease the erection of large wooden posts. Each post was presumably laid on the ground with its foot in the elongated direction of the pit. In the raising, the post would naturally slide further into the hole, as into a socket. There is no way to establish the height of the posts that were used; indentations indicate that their diameters were about 2 feet.

From the samples that were found, Wittry established that the postholes were evenly spaced around the circle at increments of 7 1/2 degrees. He found a posthole at each of the north and east cardinal directions, as measured from the center of the circle. Five feet east of the center of the circle was another posthole. Wittry found that this offset hole was in position to serve as an accurate solstice backsight. A line from the offset center hole to postholes on the circle in the northeast and southeast quadrants (foresights) marked the directions of sunrise at summer and winter solstice. The posthole at the eastern cardinal point would serve as a foresight for sunrise at the equinoxes. Since the foresight and backsight postholes were separated by about 200 feet the
Warren Wittry found several posthole circles at the Cahokia mounds in southern Illinois, near East St. Louis, and in 1970 interpreted one of the circles astronomically. Identified postholes are shown as circled dots. (Warren L. Wittry)

alignment could have been precise enough to be of some practical calendar use.

In his paper on the subject, Wittry said nothing more about other possible alignments, such as the corresponding sunset directions or the lunar standstills. In such an elaborate structure we might expect to find these and possibly others. The postholes in the western part of the circle were not located and therefore nothing can be said with certainty about possible markings in that direction, although new excavations are imminent and should clarify the situation. If the holes were regularly spaced all around the circle (presuming the circle was complete), and if the same backsight hole were used, the offset hole east of the center hole would seem to throw off the sunset positions. The other circles Wittry found were also incomplete, and in several instances they intersected each other. All four posthole circles should be carefully resur-
Melvin Fowler's map of Cahokia shows the alignment of the mounds and the entire urban complex with the north-south and east-west axes. Six of the mounds are ridge-top mounds and four of these are located at the corners, or city limits. According to Cahokia archaeologist Fowler, they may have defined the cardinal direction axes on which the city plan was based.

(Griffith Observatory, after Melvin Fowler, from "A Pre-Columbian Urban Center on the Mississippi." Copyright © 1975 by Scientific American, Inc. All rights reserved.)

veyed to establish, if possible, the complete pattern. Wittry mentioned other postholes which were not parts of the circles, and these may have been detached foresights or backsights. Recently Wittry discovered the remains of an ancient cup in a pit in front of the winter solstice sunrise post. A design on the cup seemed to symbolize the cardinal directions and the horizon extremes of the winter solstice sun.

D. Council Circles on the Kansas Plain
Representing a later, different culture are a number of low, circular mounds in Rice and Cowley counties on the central Kansas plain which are known as the "council circles." In 1967 the archaeologist Waldo
A pair of mounds, one conical and the other flat, lies upon the main north-south axis of Cahokia. (E. C. Krupp)

Three council circles in central Kansas were left by early historic Plains Indians. Waldo Wedel, in 1967, reported that they are placed astronomically and that solstice alignments may be present. (John A. Eddy)

Council Circles of Central Kansas
Wedel of the Smithsonian Institution reported that two of these, a little more than a mile apart, appeared to have been built on a winter solstice sunrise line.

The council circles were presumably built by Plains Indians of the Wichita tribe about three hundred years ago. They are found on summits of flat- or round-topped ridges. Each consists of a roughly circular mound, no more than 3 feet high and 60 to 90 feet in diameter, surrounded by a larger area of shallow, scooped-out depressions. The depressions, which extend the circle diameters to 200 feet or so, are presumably borrow pits from which dirt was taken to build up the low central mounds.

Wedel reported five council circles, all in two Kansas counties, although he surmised that there had been others now destroyed by cultivation and land development. Each of the five is closely associated with a known village complex, with one council circle per village. Wedel proposed that the raised, circular mounds were the places of residence of the elite of the Indian village and that the other Indians lived around them, in part in the scooped-out basins. Excavation of the basin areas confirms that they were used for habitation.

Three of the known council circles lie within a two-square-mile area in Rice County, Kansas, between Wichita and Salina. Wedel excavated one of these, the so-called Tobias Circle. He found that the other two, the Thompson and Hayes circles, lay on a northwest-southeast line which points to the sunrise at winter solstice. The same line in the opposite direction therefore points to the approximate place of sunset at summer solstice, although Wedel did not comment on this. He determined the alignment direction by aerial survey, and associates confirmed the winter solstice alignment of the centers of the Thompson and Hayes circles by on-site visual observation at sunrise on December 21 and 22, 1965. The distance between the two circles is about 6,400 feet, and they are plainly in sight of each other.

As further evidence that the circles were built on an intended alignment, Wedel noted that the Hayes Circle was elliptical in shape, with its major axis along the line which connected it with the Thompson Circle. He found that the third, the Tobias Circle, was also elliptically extended, but in the direction of summer solstice sunrise. From these findings, Wedel surmised that there could have been a common observation point from which a line to the Tobias site, 246 feet away, would have marked the summer solstice sunrise, and, from the same point, a line through the Thompson and Hayes circles (2,460 and 8,860 feet distant) would have pointed to the winter solstice sunrise. Wedel reported no distinctive marking at the proposed intersection point, which leaves the summer solstice (Tobias Circle) line highly conjectural. Moreover,
he did not give the measured azimuths of any of the alignments, and we do not know the uncertainties involved. A more detailed survey of the site positions is surely needed, to check Wedel’s aerial survey and to investigate other possible interalignments of the three mounds.

**ROCK PATTERNS ON THE WESTERN PLAINS**

It is probably true that at the time of the arrival of Columbus in 1492 there were but a hundred thousand Indians on the western plains between the Mississippi River and the Rocky Mountains—probably fewer than the present population of Cedar Rapids or Colorado Springs. With so sparse a population distribution we should not be surprised to find how little is known and found of the early Indians of this wide region.

The most common relic of the early Indians of the western part of the Great Plains are tipi rings—circles of stones, typically 10 to 20 feet in diameter which were presumably used to hold down the edges of hide tipis. The rings are typically found in clusters, in places where tipis would likely have been pitched. Charcoal pits are often found in and near them, and carbon dating and lichen dating have shown that some tipi rings mark campsites more than a thousand years old.

A. **Medicine Wheels**

Less known and far fewer in number than the tipi rings are a scattering of stone alignments, effigy figures, and spoked wheels called “medicine wheels.” Here the word “medicine” denotes magic or supernatural power and implies a possible association with social or religious ceremony. At least fifty western medicine wheels are known today, and they are found chiefly along the front (eastern) range of the Rocky Mountains, from Wyoming through Montana and into Alberta and Saskatchewan in Canada. Other examples, possibly related, have been reported as far south as southern Arizona.

Like the stone alignments and effigy figures, medicine wheels are simple patterns laid out on the surface of the ground with local rocks. They range in size from a few feet to several hundred feet across. Their defining characteristic is a set of spokes which radiate from a center or hub, so that, from above, each one looks like a primitive sun symbol or rayed sun. The number of spokes varies from wheel to wheel. Some wheels, but not all, have cairns, or piles of rock, at their centers or elsewhere in and around the patterns. Some of these cairns, as in the case of one large medicine wheel in Alberta, are as much as 30 feet in diameter and 6 feet high, containing perhaps 100 tons of rock and revealing considerable effort and motivation on the part of their builders. Other
wheels are more casually laid and could have been built by a single person in a few hours.

It is probably significant that all of the known medicine wheels lie on hillocks, plateaus, mountaintops, and other elevated places with clear horizon views. This can be interpreted in several ways. The Plains Indians commonly sought out high places for isolated personal contemplation and vision quests, as we are told, and these enigmatic patterns could represent their labors at these times. Or, if the wheels are simply expressions of art, as some interpret petroglyphs, it is surely the nature of artists to hang their work where it can best be seen, and prominent, high, clear areas of land would fit this urge for stone patterns. But the choice of clear horizon sites suggests another possible use for these largely unexplained structures: the horizon marking of important celestial events, such as the seasonal extremes of sunrise and sunset. The fact that medicine wheels resemble sun symbols adds weight to this possible interpretation.

I have investigated a number of medicine wheels for possible astronomical alignment: two good examples are the Big Horn Medicine Wheel near Sheridan, Wyoming, and the Fort Smith Medicine Wheel in southern Montana. Both show evidence of alignment on the sun at summer solstice. Since, in historic times, the Indians of this area held important ceremonies near the time of summer solstice—"when the sun is highest and the growing power of the world is strongest"—the alignments could have served for ceremonial calendar use. Another possible reason for marking or celebrating the summer solstice was agriculture. An assortment of Indian tribes moved through the regions where medicine wheels are found and some of these had relied upon agriculture either concomitantly with bison hunting or at an earlier phase in their history. Before the major population shifts and adjustments among the Indian tribes in the nineteenth century, domestic agriculture was important on the eastern plains, and it produced surpluses for trade throughout the region. While planting was probably never practiced in many of the rocky areas where medicine wheels are found, they may have been built there by people who had earlier agricultural traditions.

B. The Big Horn Medicine Wheel

The Big Horn Medicine Wheel, which is probably the best known of all, reveals rather impressive astronomical alignments which suggest a thorough acquaintance with the sky. It is an elaborate wheel of twenty-eight spokes and roughly circular rim, found on a clear mountain shoulder at an altitude of about 9,600 feet in the Big Horn Mountains. Its diameter over-all is about 90 feet. At the center of the wheel is a rock
Astronomical alignments between cairns of the stone medicine wheel in the Big Horn Mountains near Sheridan, Wyoming, were reported by John Eddy in 1974 (John A. Eddy)

cairn about 12 feet in diameter and 2 feet high. Around the rim are six other cairns, one of which, in the southwest quadrant, is distinctive in that it lies well beyond the rim of the wheel on an extended spoke. All of the cairns are in the form of hollow, amorphous circles which make them consistent with places where posts might have been erected in the rocky soil. This is specifically true of the central cairn, beneath which a conical hole was found in the bedrock. The central cairn was probably used as a socket for a post or gnomon—the foot of the post set in the hole and tamped with loose dirt and the rocks of the cairn heaped around it for support. The other cairns, if used in a similar way, would have made the structure at one time a primitive woodhenge, although this is highly conjectural.

A line from the distinctive southwest cairn on the extended spoke through the center cairn points within about 0.2 degree to the place of rise of the sun at summer solstice. A line from another of the principal
cairns to the center cairn marks the place of sunset on the same day, adding strength to the hypothesis of astronomical use, for if the dawn was cloudy, the sunset could have been tried. The possibility of chance alignment of two of six cairns on specific directions of sunrise and sunset at summer solstice is about one in four thousand.

Three of the remaining cairns of the Big Horn Medicine Wheel are positioned, by further chance or intention, to mark the points of rise of the three brightest stars of summer dawn: Aldebaran in Taurus, Rigel in Orion, and the brightest star of all, Sirius, in Canis Major. These stars, which we see so clearly in autumn and winter nights, rise just before the sun in summer. On certain specific days in summer they rise heliacally—that is, they appear at the horizon only momentarily and then fade into the light of dawn. The heliacal rising of the brightest stars provides a method of marking a calendar date which was used, we believe, by many early peoples. In the period between about A.D. 1400 and 1700 the one bright star in the sky whose heliacal rising marked the time of summer solstice at the Big Horn site was Aldebaran. Its marking by cairn alignments seems plausible and intentional, especially since archaeological dating of the site agrees with the use of the Big Horn Medicine Wheel in this period of time.

In the same period Rigel rose heliacally twenty-eight days after Aldebaran, and Sirius rose heliacally about twenty-eight days later still, in August, marking the end of tolerable weather on the mountaintop. It may be significant that there are twenty-eight spokes in the Big Horn Medicine Wheel, which might have been used for day counters.

And it may be completely unrelated, for the number 28 was a favorite of the Indian: There are 28 ribs in the buffalo. The number of days in a “moon,” when precisely measured over long periods of time is 29 1/2, which is close to 28; in primitive observation the difference would be subtle and hard to detect, since the exact time of new or full moon is uncertain by a day or so. Many reasons might dictate 28 spokes. It is my feeling, confirmed in part by archaeological investigation, that the spokes of the Big Horn Medicine Wheel are late additions to the structure and may have been added merely as a decoration and sun symbol.

C. Other Medicine Wheels
The astronomical alignment of the Big Horn Medicine Wheel has been known only since 1972, and as yet few of the other known wheels have been investigated in detail for possible similar alignment. The Fort Smith Medicine Wheel, on the Crow Indian Reservation in southern Montana, is a simpler structure with six spokes which radiate from a simple circular hub at the center. It lies on a flat hilltop and the spokes run down over the side of the hill. There are no associated cairns. If the
Fort Smith Medicine Wheel
Montana

The longest and most distinctive spoke of another, smaller medicine wheel, at Fort Smith, in southern Montana, aligns with the summer solstice sunrise. (John A. Eddy)

center of the Fort Smith wheel is taken as a foresight and marked with a post, the longest and most distinctive of the spokes points to sunrise at summer solstice, as confirmed by transit measurement and by observation at the time of summer solstice.

Thomas Kehoe, an archaeologist with the Milwaukee Public Museum, who has mapped a number of medicine wheels in Montana and Canada, has pointed out the striking similarity of the Moose Mountain Medicine Wheel in Saskatchewan with the Big Horn Medicine Wheel. Cairns of the Moose Mountain wheel appear in position to mark the same celestial features as those at the Big Horn wheel: sunrise at sum-
The Big Horn Medicine Wheel in Wyoming and the Moose Mountain Medicine Wheel in Saskatchewan, Canada, have similar arrangements of cairns. Both plans include alignments on the summer solstice sunrise and on three bright stars of the summer dawn. The Saskatchewan wheel is larger and also probably much older. (John A. Eddy)

Summer solstice and the rising of Aldebaran, Rigel, and Sirius. A small group of rocks arranged in the form of a sun symbol, with short rays, was found at the end of the Moose Mountain wheel's summer solstice sunrise spoke. A recent survey on the site has confirmed the summer solstice alignment on sun and stars and suggests that the Moose Mountain site may predate the Big Horn wheel by one thousand years or more.

In earlier discussions with Indian informants of the Blackfoot tribe, Kehoe was consistently told that medicine wheels were built to mark the place of death of important chiefs. Some were known which had been built within the last century for this purpose. It seems likely that different medicine wheels, like mounds or other structures, were built for different reasons, by different people at different times. Or it is entirely possible that the same medicine wheel may have been used for different purposes. More of the known wheels must be investigated if we are to become convinced of their real origin and possible astronomical use.

D. Rock Alignments

Human-made lines of rocks on the western plains are even less studied, harder to find, and less certain to interpret. Some are associated with
bison pounds, to mark drive lanes. Many others are not. The author has investigated one of the recognized examples which lies in the Rocky Mountain National Park in northern Colorado, near Trail Ridge Road at an altitude of about 11,400 feet above sea level. Two lines of stones, each about 50 feet in length, meander roughly northeast and southwest downhill from a crude cairn on a rocky crest near an old Ute Indian trail. The stones are local magnetite and are sunken into the shallow mountain soil, indicating a certain antiquity. A sightline from the end of one of the two “spokes” to the center cairn (as a foresight) coincides with the local direction of sunrise at summer solstice. The line is not straight—although it may have shifted with the soil—and it is quite possible that the solstice alignment is purely accidental. But it fits a pattern of summer sun alignments which have logical basis and which seem confirmed in a growing number of sites.

It is interesting to wonder why a solstice line might have been drawn at that high, cold, inhospitable place. No one who has driven the summit of the Trail Ridge Road—the highest highway in the United States—would ever propose that agriculture was practiced there. And any who step from their cars into the thin, biting winds of June will probably agree that only the masochistic would schedule celebrations there, at any time of the year. But I do not think we need invent practical reasons for every solstice marker, any more than we ask practical purposes for other religious or symbolic acts. I am prepared to think that an Indian who knew the simple secrets of the sun’s recurrent path would find a certain pleasure in demonstrating his grasp of the sky by marking it in stones, sometimes in illogical places and for reasons that will be forever lost.