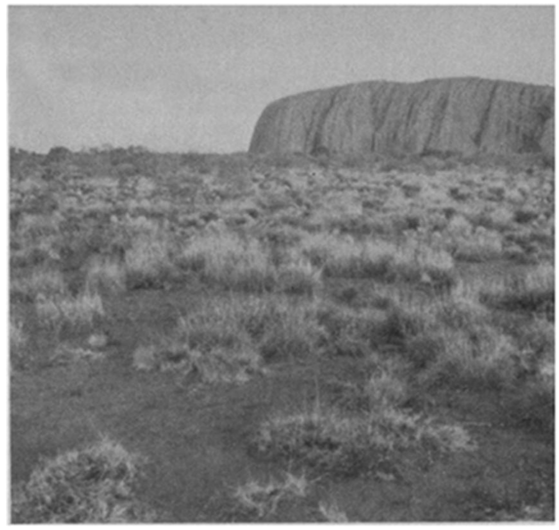
# The Old and the Ethnic in Astronomy



Prescientific and ascientific astronomy are serious historical and aesthetic interests. They can also affect modern astrophysics and geophysics.

By DIETRICK E. THOMSEN

Archaeoastronomy — or, as it is sometimes called, ethnoastronomy — is one of those things that are hard to define precisely but everybody involved in them knows what they are. The subject includes prescientific astronomy, and so encompasses the astronomy of the ancients — Egyptians, Babylonians, Hebrews, even Greeks and Romans — and possibly everything down to Tycho Brahe.

The subject also includes the astronomy of modern peoples who have not been influenced by advanced scientific culture — but who, exactly, are these? Doubts have been raised, for example, about the propriety of including the Crow Indians of 19th century Montana. The Crow may have been too much influenced by their contacts with Europeans to qualify, critics objected at the session devoted to archaeoastronomy during the recent meeting of the American Astronomical Society in Pasadena, Calif.

However, if any group belongs, the Australian Aborigines probably do. In Aboriginal legends of the "dreamtime," the period before the creation of the present order of things, are a number of stories in which characters are turned into celestial objects. William C. Straka of Lockheed Research and Development Division in Palo Alto, Calif., was in Australia last year to observe Comet Halley, and while there he decided to look for astronomical references in the Aboriginal rock art at two sites, Ayers Rock and Ewaninga, located near Alice Springs. There Straka found drawings that might relate to these stories.

In addition, he found a notch in the entrance to Fertility Cave, a cavern in Ayers Rock, that aligns with the edge of the rock to provide a small window looking in the direction of the sunrise at the equinox. He found some similar alignments in other places.

Questioned about these things, the Aborigines deny any significance and say the drawings are just abstractions. However, Straka points out, the sites are connected with the Aborigines' religion, and that happens to be a very secretive religion with lore closely guarded from noninitiates. As noninitiates include most of the men and all of the boys and women in the tribe, it is unlikely that those in the know would reveal the secrets to a visiting foreigner. "Maybe they're not telling us everything," Straka says.

Written records come down to us from ancient Mediterranean cultures, but they may not be telling us everything either. Certainly the interpretation of what they *are* telling us can cause controversy, as the dogged question of the star Sirius illustrates.

The question is whether Sirius was red during a period in historic times. Sirius looks blue-white now, but if it was red in ancient times, as Fred C. Bruhweiler of Catholic University of America in Washington, D.C., told the Pasadena meeting, that could be important for modern theories of how white dwarf stars evolve.

At a magnitude of −4, Sirius is the brightest star in the sky, and there are many ancient references to it. Sirius was important to the ancient Egyptians. When it rose with the sun on summer mornings, it signaled the coming of the Nile flood. Egyptian records do not specify the color of Sirius, but an early Babylonian record says Sirius looked like polished bronze armor. Bruhweiler asks, "Does that refer to the sheen or to the copper color?"

To the ancient Greeks and Romans, Bruhweiler notes, red celestial bodies denominated angry gods. Sirius, the dog star, associated with the dog days of summer and the attendant sickness and drought, was classified with such incontrovertibly red objects as Mars and Antares. The Romans sacrificed red-haired dogs to it. The last reference to an apparently red Sirius comes from Gregory of Tours in A.D. 570; by 980 there are definite references to a blue Sirius.

Assuming Sirius was red for a millennium or a millennium and a half, astrophysicists have tried to find explanations. Sirius is a multiple star system, with at least three components orbiting their common center of gravity. This discussion concentrates on the main components: Sirius A, a star of spectral class A twice as massive as the sun; and Sirius B, one of the most massive white dwarfs known. What we see today is mostly Sirius A, but the theories deal with what may have happened to Sirius B.


Straka

*Ayers Rock is a kind of small mountain, an outcropping in the Australian desert near Alice Springs. It is a famous site of Aboriginal rock art. This view is from the west at sunset.*

One suggestion is that the white dwarf underwent an eruption that left the system surrounded by a shell of dust. The dust would have turned the outcoming light red. But, says Bruhweiler, it would have seriously dimmed Sirius, to a magnitude of +1.6. "I wouldn't go sacrifice dogs to a star of magnitude 1.6," Bruhweiler says.

He prefers an explanation involving a thermonuclear runaway, a process involving mass loss and residual thermonuclear burning according to a carbon-nitrogen cycle. Happening with just the right conditions, this could produce a bright red Sirius. The white dwarf would mimic a red giant for several centuries and completely outshine Sirius A.

Kenneth Brecher of Boston University objects that Sirius may never really have been red. He refers to an ancient Chinese record that called Sirius white. He also points out that color words are hard to translate, especially from ancient languages. Different cultures have different ways of seeing color, so how can we interpret precisely such Latin phrases as *rubeola* or *rutilo cum lumine*? That some of the records really refer to Sirius is also uncertain. Bruhweiler and Brecher agree that there may never be a certain answer.

A more certain calculation—and one of possible interest in geophysics—seems to come from study of the day in ancient China when the dawn came twice. According to Kevin Pang of Caltech in Pasadena, who worked it out with Kevin K. C. Yau of the University of Durham, England, and Hung-hsiang Chu of the University of California at Los Angeles, the calculation gives us our oldest knowledge of the rotation rate of the earth.

According to the chronicle known as the Bamboo Annals, the dawn came twice on a day in the first year of King I, in King I's capital, the city of Zheng (in present-day Shaanxi province). Pang points out that, as the dawn rises, the sky brightens by a factor of a million. If a total eclipse of the sun occurred before the sun came above the horizon, the sky would brighten, then darken, and then brighten again. A computer program written by F. Richard Stephenson of Durham University enabled Yau to calculate that such an eclipse had happened at Zheng on April 21, 899 B.C., a date that fits the reference in the annals.

From this determination, they were able to calculate the earth's rotation rate at that time, the earliest date for which a number has been determined. As expected, the rotation was slightly faster then than now, but there is a slight discrepancy from the figure that would be calculated by allowing for the continual slowing caused by tidal effects.

Sunrise is important to sun worshippers, such as the ancient Nabateans. At the meeting, Brecher presented an analysis of a Nabatean site called Avdat, now located in Israel about 64 kilometers south of Beersheba. He says the site, which he investigated with his wife, astronomer Aviva Brecher, and their children, Karen and Daniel, may be the first archaeological example of a solsticial orientation in the Near East.

The Nabateans were a Semitic people who lived in the desert east of Syria, Galilee and Judea. Their worship of the sun may account for the orientation of the buildings at Avdat, Brecher suggests. The main building there is a kind of temple fortress aligned with its main axis along the azimuth that runs from the point of winter solstice sunset to that of summer solstice sunrise. The ancient Semites were known for an interest in the equinoxes — the major Hebrew festivals came at the equinoxes, for example — but this would be the first evidence of an interest in the solstices.

The solstices, Sirius and other stars prominent in summer are of interest to people who want to keep track of the summer season. This is particularly important to people who, like the aforementioned Crow Indians, live in a northern climate: It tells them when to get out their furs and woolies, and it seems to have been the purpose of the medicine wheels they made. Indeed, archaeoastronomy seems to have begun with work on the medicine wheels of Native Americans, done in the 1960s and '70s by John Eddy of the National Center for Atmospheric Research in Boulder, Colo.

In 1986, Jack H. Robinson of the University of South Florida in Tampa went back to a medicine wheel near Ft. Smith, Mont., that Eddy had earlier studied. A medicine wheel is a circle of stones with spokes laid out on the ground. As Eddy determined, an observer standing in the center of the circle could use the spokes and objects on the horizon to sight to the rising or setting of astronomical objects. Robinson wanted to find out exactly what objects the spokes of the wheel at Ft. Smith referred to.

His primary finding was a precise determination of the altitude and azimuth of a knoll on the southeast horizon. From the known history of the way stars change their positions in the sky, Robinson determined that in 1847, an observer standing in the center of the circle would have seen the star Fomalhaut—which rises with the sun shortly before the summer solstice—rise over that knoll. This seems to indicate that the wheel was built in the 1840s, and the date roused some question as to whether the builders might have been "contaminated" by modern astronomical ideas communicated to them by Europeans and Americans, who had already been visiting them for half a century or more.

Other azimuths on the Ft. Smith wheel point to the stars Rigel, Aldebaran and Sirius, whose heliacal (near the sun) risings help chart summer. A prominent tree on the southwest horizon gives a sight to the winter solstice sunset.

All human cultures see the sky, and all seem to have had some astronomical interest. Whether they are telling us everything, and how much their thought was influenced by scientific astronomy, are basic questions for archaeoastronomy. □