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Big Horn Medicine Wheel: Why Was It Built?

Eddy (*1*, p. 1042) offers two hypotheses to explain how the Big Horn Wheel could have been built: First, the construction can be viewed as the next step in the expansion of the indigenous astronomical system; second, the technique of astronomically aligning cairns could have been learned from Pueblo people to the south.

As the author of the paper to which Eddy refers for support of his second hypothesis (*2*), I think that his *first* suggestion is more plausible; that is, the construction followed "naturally" from the astronomical knowledge already possessed by the northern plains people. In other words, granted that the builders of the Big Horn Wheel were making celestial observations and had the technical skill necessary to incorporate these observations into the construction at the time the Wheel was built, the structure is one way of permanently recording these observances for year-to-year use (*3*). A major problem, of course, is that, because of precession, the three stellar alignments (Aldebaran, Rigel, and Sirius) would be inaccurate and therefore useless within a few hundred years after they had been set; solar alignments would remain accurate. The main point, however, is that, in this case, no diffusion of either astronomical knowledge or the techniques of aligning architectural features to celestial rise-set points need be posited. As noted below, the necessity for understanding seasonal change and for planning subsistence activities accordingly provides us with an adequate hypothesis to explain the construction of the Big Horn Wheel.

Eddy (*1*) also raises the question of why the structure was built. In answer to the question "Why would a nomadic people wish to mark the solstice?" (*1*), he suggests ritual and "a basic need to plan for colder weather" as possible reasons. If by the latter Eddy means that the Big Horn Wheel was used as a device for increasing the efficiency of subsistence activities, then we are in agreement. The understanding of seasonal change is of prime importance to all peoples; it is most crucial to those who obtain their subsistence *directly* from the land or the sea, and the more specialized their adaptation, the greater their need for accurate predictions of seasonal variability. Thus one can hypothesize that the Big Horn Wheel was constructed as a fixed calendrical reference point for use in determining seasonal changes and for predicting (i) the movements of animal populations upon which subsistence partially depended (this may account for the possible lunar count as represented in the 28 spokes of the Wheel, although, if these spokes do represent a lunar count, then one should reasonably expect to find lunar alignments of the cairns; Eddy does not indicate the presence of any lunar alignment), and (ii) the availability of important plant foods at various locales within the group's econiche. Furthermore, as Lowie (*4*), among others, has pointed out, many Plains groups, particularly in the Historic period, relied on agriculture as a significant part of their subsistence base; thus the Big Horn Wheel may have functioned, in part, as a calendrical device in the implementation of the agricultural cycle. [Another possible function, suggested by Kehoe (*5*), is that medicine wheels were used to mark the graves or places of death of important war chiefs and medicine men.]

Indeed, the lack of a specific, testable hypothesis to explain the adaptive functions of the Big Horn Wheel is the major weakness in Eddy's article; this shortcoming is also evident in much of the current archaeoastronomical research (*3*). Yet it is clear that, among most cultures, astronomical observations fundamentally serve in the planning and execution of subsistence activities (*6*). Therefore, the rituals usually associated with the observations (*6*) can be understood to be part of this adaptation (*7*). Moreover, it is precisely at the point when such ritual, for whatever reason, is diverted from its original adaptive function that the greatest threats to the survival of the system are seen to arise (*3*).

One final point needs to be made. If one argues, as I have, that the Big Horn Wheel served this adaptive function, then it is necessary to demonstrate that the energy expenditure (in calories) required to build the structure resulted in increased energy production: energy production *after* construction must exceed energy production *before* construction. There must be a marked increase in the efficiency of subsistence techniques in order for the construction to be worthwhile. If not, then that part of the system, predictably, should fall into disuse. Perhaps this is what happened in the case of the Big Horn Wheel; it did not function as expected. In addition, as the specific stellar alignments became unreliable, the entire system was eventually rejected by those who had built and used it (*8*). One might use this argument as one testable hypothesis to explain the abandonment of the structure, and future research at the site should perhaps be directed toward this aspect of the problem, as well as toward other issues which have been raised.

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The intended point of my article was to present evidence that the cairns of the Big Horn Medicine Wheel are astronomically aligned with the rising and setting azimuths of the summer solstice sun and with three bright stars of summer dawn that could have been used for heliacal reference. This is all that archaeo*astronomy* can say, and the limit of what is really testable. Anything beyond this is speculation.

All of Reyman's comments deal with this second realm and hence lie outside the reach of useful comparison or test. In general, I think that, in proposing more elaborate explanations, he has overlooked the description of the site and its setting; it is remote, crude, and not a part of any lasting settlement. It is unlikely that the site was abandoned as a consequence of celestial precession. To this day Aldebaran, Rigel, and Sirius still rise in rough alignment with the cairns. The precessional change of these stars is chiefly in the right ascension coordinate; their rise-set points are fixed by their declinations, which have changed only negligibly in the past centuries.

We apparently disagree on the more substantive and crucial issue of the current health of archaeoastronomy. Reyman states that much of the current research in this cross-disciplinary field suffers from a lack of hypotheses. I would agree that the patient is sick, but my diagnosis is precisely the opposite.

For a hundred years and more archaeoastronomy has been a weak field, not because of a lack of speculation but from an overindulgence in it, and a concurrent deficiency of painstaking measurement and skeptical remeasurement. Investigators have seldom taken the time to establish each case factually and firmly and have too often fallen into the trap of never announcing a measurement until they had a theory to back it up. Sir Norman Lockyer's 19th-century findings on the celestial alignments of Stonehenge and the Egyptian monuments were lost in this way, when he unfortunately shifted emphasis from fact to fancy and was caught in a web of overelaboration.

We have always been too quick to leave the harder work and jump to the conclusions, to avoid the more difficult tests and extensions of measurement and to debate instead the hypotheses. Some of each is surely necessary. But if archaeoastronomy is ever to win the attention and respect of the other fields it serves, it must first establish its credibility and its credentials. In a doubting world this is usually done by exposing observational evidence to the rigors of test and cross-examination. This requires that we publish more quantitative claims and that we write and argue more about measurements than about hypotheses. I am personally encouraged that the trend of current research in archaeoastronomy is in this direction.

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Irrigation Increases Rainfall?

Fowler and Helvey (*1*) investigated the effect of irrigation on climate in the Columbia Basin, Washington, and concluded that there was no effect and that my 1967 claim (*2*) of a significant increase in precipitation "does not appear sound." To help resolve the question, I have tested the data available for 7 years since 1966, and I find that my original claim is strengthened.

July and August rainfall in the Columbia Basin was 50 percent higher during the period 1955 through 1973 compared with the period 1931 through 1950. For the region outside the basin but within 150 miles (240 km) of its center the increase was 23 percent. Between the two periods, from 1950 through 1955, irrigation water from the Grand Coulee Dam became available and was applied to 400 square miles (approximately 100,000 hectares) of formerly near-desert land in the center of the basin. The inference is that irrigation increased the summer rainfall.

In 1967, using 12 years of postirrigation data, I was able to show a significant increase in July and August rainfall in the basin. Four of the 12 years were used to explore the problem

Table 1. Tests for significance of precipitation increase. The number of stations is given for the start and end of the period. Abbreviations: T and C, percentage increases for target and control gages, respectively; S.D., standard deviation $= [\overline{(T - C)^2} - (\overline{T - C})^2]^{1/2}$; $t = (T - C)(n - 1)^{1/2}/\text{S.D.}$; n, number of years (successive years are assumed independent); and t_{95} and t_{99} are values from the one-tailed t-test at $P = .95$ and $P = .99$, respectively, for $n - 1$ degrees of freedom.

Period, stations	Number of stations	Precipitation (inches)		Mean/normal (%)	$T - C$ (%)	S.D. (%)	t	t_{95}	t_{99}
		Mean July + August	Normal (1931–1950)						
1959–1966									
Target	55–55	0.99	0.545	181.7					
Control	47–47	2.37	1.624	145.9	35.8	43.6	2.18*	1.895	2.998
1967–1973									
Target	52–46	0.625	0.537	116.4					
Control	44–41	1.54	1.59	96.9	19.5	28.1	1.73	1.94	3.14
1959–1973									
Target	55–46	0.81	0.539	150.3					
Control	47–41	1.99	1.62	122.8	27.5	37.9	2.71**	1.76	2.62

* Significant at $P = .95$. ** Significant at $P = .99$.