THE PREDICTIVE DIMENSION OF PRIESTLY POWER

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ABSTRACT

Pueblo priests used esoteric knowledge to predict seasonal changes and astronomical events, and their power increased or diminished with their ability to "control" these phenomena. Inaccurate predictions often resulted in discord and possibly in charges of witchcraft. The use of this ethnographic/ethnohistoric model for studying prehistoric Anasazi sites is discussed.

THE PREDICTIVE DIMENSION OF PRIESTLY POWER

> The man who went to the Sun was made Pekwin[3] [[3]Pekwin "cares for the sun." He observes its movements to determine the ceremonial dates.] The Sun told him, "When you get home you will be Pekwin and I will be your father. Make meal offerings to me. Come to the edge of the town every morning and pray to me. Every evening go to the shrine at Matsaka and pray. At the end of the year when I come to the south, watch me closely; and in the middle of the year in the same month, when I reach the farthest point on the right hand, watch me closely." "All right." He came home and learned for three years, and he was made Pekwin. The first year at the last month of the year he watched the Sun closely, but his calculations[1] [[1]For the winter solstice] were early by thirteen days. Next year he was early by twenty days. He studied again. The next year his calculations were two days late. In eight years he was able to time the turning of the sun exactly. The people made prayersticks and held ceremonies in the winter and in the summer, at just the time of the turning of the sun. (Benedict 1935:II:66-67)

The ethnographic and ethnohistoric literature for the southwestern Pueblos contains many accounts such as the one above, accounts which describe how Pueblo priest come to power, their duties and responsibilities, and the consequences of their behavior in terms of the behavior of the inhabitants of their villages. Despite almost 400 years of acculturation, many of these activities continue today, albeit in attenuated forms.

One major duty of the priest is astronomical observation. Except at Laguna, where the native astronomical practices have ceased, each pueblo has an official "sunwatcher" who makes and records apparent solar movements (Ellis and Hammack 1968; Parsons 1939; Reyman 1971, 1975, 1976a, 1976b).

> As is the case with all other agricultural people, the Pueblo Indians are dependent to a great extent upon the sun. Consequently, they are intensely interested in the sun's movements. (White 1942:205)

At some pueblos, the same official is also responsible for lunar and stellar observations; at other towns, another priest or group of priests has this duty (e.g., Bunzel 1932; Parsons 1939; Reyman 1971; Stephen 1936; Stevenson 1904). The data from astronomical observations, in conjunction with observed changes in flora and other natural phenomena,[1] are used, in part, to establish and maintain calendars for the scheduling of subsistence activities and for the organization and ordering of the associated socioeconomic and ritual behaviors, e.g., irrigation ditch maintenance, field preparation, communal collecting and hunting activities, and katsina dances (e.g., Beaglehole 1937; Benedict 1935; Bunzel 1932; Forde 1931; Fewkes 1920; Parsons 1939; Reyman 1976b; Stephen 1936).

Observations of stars along the ecliptic are also used as nighttime checks on the sun's position. These observations are most useful in winter when sunrise and sunset are often obscured by clouds or other adverse weather conditions, sometimes for several days in succession. Finally, observations of bright stars—most commonly the Pleiades, the belt of Orion, the Sirius—and observations of Venus, both as Morning and Evening Star, are frequently used, especially among the Hopi and Zuni, to time parts of ceremonies, i.e., the appearance and disappearance of these stars in the night sky, often observed through kiva hatchways, are taken as signals by the priest(s) to begin or end an aspect of a particular cemermony. For example:

> About three, Orion was spoken of as being high enough in place, and all the inmates of the chamber took up their prayer sticks from the various trays along the pollen trail, and, with their rattles, etc., Si´mo leading with his moisture rattle, all went out to Antelope mound court. Venus is just well clear of the horizon. (Stephen 1936:813)
>
> When Orion got about due south as seen from the floor through the kiva hatch . . .Su´pelă . . .made three lines with prayer-meal and set the crenellate bowl in the centre, . . . (Stephen 1936:890)
>
> The Pleiades were just overhead, but in the south, and the moon had just fairly risen when the altar ceremonies began. (Stephen 1936:891)
>
> They are waiting for the Pleiades to come overhead . . . and at 10:40 the Pleiades and Orion (Wutom´kami) were overhead. Anawi´ta . . . said when Pleiades got over there, pointing about and hour and a half ahead, come back here and go with us to Singers kiva. (Stephen 1936:969)
>
> Just as the morning star was rising, the music ceased, the congregation became silent, and the chief dancer was led to the center of the room, where he was elaborately costumed. (Cushing 1967:26)

These aspects of Pueblo ceremonialism are discussed at length in the above mentioned sources, and I have also considered them in conjunction with research on the sunwatchers, *per se* (Reyman, 1971, 1976a, 1976b).[2]

PUEBLO ASTROMOMY AND THE CORRELATES OF PRIESTLY BEHAVIOR

This paper is addressed, however to other issues: The consequences of both accurate and inaccurate predictions by priests[3] of astronomical events such as the solstices; the kinds of behavior which follow when the seasonal changes occur in the environment as predicted by the priests; the nature of the people's response when seasonal changes do not follow expectations. Ethnographic data are available which can be used in the analyses of these issues, i.e., toward the study of material results or correlates of priestly behavior. These same data are also useful for research into prehistoric contexts.

It must be noted here that this paper is a preliminary statement based on current research (Reyman ms.) and that both the general framework and specific aspects may be revised as the work progresses. Thus, this paper should not in any way be viewed as a final analysis; rather, it is meant to stimulate discussion and other research toward a better explanation of the data.

Generally, the Pueblo complexes discussed herein are best understood if the reader keeps in mind that they operate as systems of checks and balances: Priestly orders check the power of each other and are, in turn checked by the villagers; society memberships (medicine, war or scalp, katsina, etc.) crosscut village organization and bind people to the ceremonial groups headed by the priests. This checks or places limits on dissent; priests can reduce threats of their positions by suggesting that they will not perform the important ceremonies for which only they have the required secret knowledge; and nature serves as the ultimate check on all because climatic conditions and seasonal changes are not as predictable as expected or desired. Therefore, the ethnographic data, although discussed under several categories, should be understood as integral elements within the larger Pueblo sociopolitical and economic context.

The Western Pueblos. The Hopi and Zuni have more complex astronomical systems than do the eastern Pueblos. Not only do these western peoples make careful solar observations, but they also watch closely the movements of the moon and stars. As noted above, stellar movements are used as timing mechanisms for ritual activities (Venus, a planet, is considered to be a star)[9]

Both the Hopi and Zuni attempt to coorelate their solar and lunar calendars.

> . . . it was easy task for the Hopi to keep their calendar straight . . . partly because they tried to reconcile lunar and solar phases. The attempt to fit thirteen moons evenly into the two equal periods of time between the solstices of the year was over-ambitious . . . it was not unusual for the men in charge to skip or lose track of a moon in their count. (Titiev 1938:39)

During the past several hundred years, perhaps starting as early as A.D. 1000,[10] the Hopi sun-watchers developed highly accurate solar horizon calendars. The priest use these calendars to predict seasonal changes in the environment, most often in terms of weather conditons, and to announce the best times for planting, the concomitant ceremonies, and the various other socioeconomic activities on which village life depends (e.g., Beaglehole 1937: Forde 1931; Parsons 1925, 1933; Stephen 1936; Titiev 1938).'' These horizon calendars are also used by the priests in their efforts to reconcile or synchronize solar and lunar movements. Previously, calendrical errors such as the loss of a moon in the lunar count were regarded as catastrophies and were thought to cause bad weather (Titiev 1938:39, 39 n. 1). Also,

> We think the Sun-watcher is not a very good man. He missed some places, he was wrong last year. And I think he is going to miss or take on some place (i.e., to observe inaccurately). all the people think this is why we had so much cold this winter and no snow. (Parsons 1925:75)

Traditionally, calendrical errors followed by bad weather often caused sanctions to be brought against the *ta´wa moñwi* (Sun Chief or sunwatcher), including charges of witchcraft. Witches are universally feared among the Pueblos and are thought to be responsible for all sorts of misfortune such as crop loss and bad weather. Anyone may be a witch, even priests or one's closest relatives (e.g., Parsons 1939; Simmons 1942). As Parsons (1939:154) notes, ". . . chiefs are peculiarly open to the change of witchcraft. 'The best men of the pueblo may be witches' (Laguna).'' Ultimately, a witch may be killed, especially when the conditions which precipitated the charges of witchcraft do not improve, or if additional misfortune should occur.

When observational errors or calculation mistakes are made, corrective measures, usually in the form of special ceremonies, can be taken to compensate for the errors (e.g., Parsons 1925, 1939). Vigorous attempts are made through these rituals to restore balance and harmony—homeostasis—to the system. During such time, priests are expecially careful when making their observations.

> . . . Snake chief says that he wants to call out as soon as sun gets to the place. So he has to watch very closely. He wants to do what is right. He wants to do his best. (Parsons 1925:101)

In recent years, however, with the decline in the importance of farming and a weakening of the traditional culture, calendrical errors have caused fewer serious consequences. Rather, teasing and joking may take place, village life is no longer disrupted, and charges of withcraft no longer seem to be made against the sunwatcher, as was once the case.

> At Hotevilla in 1933-34, the loss of a moon delayed the performance of the winter rituals approximately a month beyond the celebration of the same ceremonies at all other Hopi pueblos. Much teasing was exchanged back and forth, but no serious objections were raised. In the spring, the officers of Hotevilla recognized their error and skipped a moon in order that the planting dates might get back to schedule. (Titiev 1938:39 n. 1)[12]

Much the same sort of astronomical system is found at Zuni, with one added element—the winter solstice should coincide with the full moon:

It seems likely that Pueblo priests use their esoteric knowledge of astronomical phenomena to increase their power and prestige. Predictions of the sun's reversal of its apparent movement along the horizons are politically important; when successful, these predictions increase a priest's power because they demonstrate his "control" of astronomical phenomena and, to some extent, of the cosmos.

> . . .it may be that the time set for "calling the sun back" intentionally preceded the true solstice in order that it could be claimed that the recall was actually achieved. Similarly, late in the fall, after the main harvests, the reversal of the sun's course along the eastern horizon might have been intentionally anticipated in an effort to impress laymen with the powers of the medicine societies. (Lange 1959: 321-322; cf. Titiev 1960).

Pueblo astronomy is far from a monolithic system, however, and marked differences are present in native astronomical practices as one moves from village to village. Some of these differences probably originated in prehistoric times and the early historic period as results of different responses to local environmental factors.[4] Other differences may have resulted from the operation of one or more complex, and as yet poorly understood, historical processes including village disintegration (Old Oraibi), the development of outliers (Moenkopi), interpueblo marriage and migration (Pecos to Jemez), fusion (Zuni), and so forth. Still other aspects of this variation can be attributed to the differential effects of Spanish and later acculturative pressures on the individual pueblos. Nevertheless, today at least two levels of complexity are discernible.

The Eastern Pueblos. The simpler systems are found in the eastern Pueblos. At Taos, Jemez, among the Keres,[5] and the other eastern villages, it is believed that the *cacique*[6] "controls" the sun's movements and can direct their reversal, when necessary. At times, especially in winter, the priest performs rituals to speed the sun's movement northward, to hurry the arrival of summer: "Sometimes the Masewi hurries it [the summer solstice] to make the summer longer." (White 1942:205; cf. Titiev 1960).

Most of the eastern Pueblos recognize the moon, often consider it a deity,[7] and have named lunar months as at Taos (Parsons 1936, 1939). Nevertheless, the moon is relatively unimportant in terms of precise astronomical observations (e.g., Goldfrank 1927; Lange 1959; Ortiz; White 1932a, 1932b, 1942, 1962).

> In contrast to a popular conception of American Indian "moon counts" for months of the year, it is interesting that no such reckoning is found among the Cochiti. Modern references to the months of the year are in Spanish or English, and there is no Keresan counterpart; this appears to be true in the past also. The word for *moon* is ta watsh; *month* is tzash'tye-ta'watsh, and there appears to be no elaboration of these terms. (Lange 1959:322)[8]

Stars are also recognized and observed, especially Venus as both Morning and Evening Star, the Pleiades, Orion, and the Milky Way (Parsons 1939; Reyman 1971, 1976b; White 1962); but stellar observations are secondary to sun watching. Although it is possible that some ethnographers overlooked the importance of astronomical observations other than solar ones, the general paucity of data on lunar and stellar record keeping suggests that, at least in recent years, priests in the eastern Pueblos spend relatively little time observing astronomical phenomena other than the sun (Ellis 1975; Reyman 1971). Finally, the statements of Pueblo informants support this inference. The *cacique* and other priests are spoken of as controlling the sun's movements, not the movements of other celestial bodies.

Of course, the *cacique* and other priests do have "real" political control over various village activities, including many connected with farming; also irrigation and other water control systems do

effect productivity. Nevertheless—and this may be a "chicken-and-the-egg" problem—it seems that the development of significant priestly power *first* resulted from accurate predictions of seasonal changes which, in turn, permitted more efficient scheduling maintenance work on irrigation ditches, water control gates, and so forth (Lange 1959). Thus "real" control developed from "apparent" control, after which the two systems appear to have reinforced each other.

> However, the Zuñis seem never to have been able to decide on the relative merits of solar and lunar calendar [*sic],* and the desire to have the observation of the solstice occur at the full moon disarranges the calculations and naturally leads to dissention [*sic]* among the various priests. However, the date is definitely set by the Pekwin and the others, whatever their views, fall into line. (Bunzel 1932:534)
>
> The p̂ekwin is the most revered and most holy man at Zuñi. Even in this society which diffuses power and responsibility until both become so tenuous as to be almost indiscernible, the p̂ekwin is ultimately held responsible for the welfare of the community . . .
>
> As priest of the sun he is keeper of the calendar. He sets the dates for the solstices, from which all other ceremonies are dated. His calculations are based on observation of the sunrise in winter and the sunset in summer. These observations are made at shrines outside of the village. When the sun rises (or sets) behind certain landmarks, the date for the solstice is at hand. However, the calendar is disarranged by the desire to have the celebration of the solstice coincide with the full moon, and the p̂ekwin is the subject of bitter criticism when the sun fails to oblige in this matter. (Bunzel 1932:512)

It must be noted that it is *impossible* to reconcile the solar and lunar calendars (cycles) so that the winter solstice always coincides with the full moon. In fact, these two events do not occur together even half the time. The Zuñi and Hopi priests cannot possibly accomplish what they ultimately seek to do and what is apparently expected of them. Furthermore, contrary to Stevenson's (1904:393) contention that few except the poor and unfortunate are tried for witchcraft, at Zuñi, as at Hopi and many other pueblos, a priest who fails in his duty may find himself accused of witchcraft. As Stevenson notes on the same page:

> Several years ago the droughts were very serious, and a retired sun priest was suspected and impeached, and his place was filled by another. The people whispered among themselves, "He is a sorcerer." (Stevenson 1904:393)

The underlying reason why the priests must fail more often than not in their efforts to reconcile the solar and lunar calendars at the winter solstice is that there is a basic 19 year periodicity in the conjunction of the two cycles. This periodicity, however, is internally variable, mainly because one needs to round off the solar year (365.242199+days) and the lunar month (29.530588+ days), neither of which is a whole number or evenly divisible by the other. This rounding problem, plus several astronomical factors, cause a shift in the calendar date of the winter solstice: It occurs usually on 21 December, but occasionally falls on 20 December or 22 December.[13]

Several other points must be made. First, given the stated goal of having the winter solstice coincide with the full moon, the best that the Zuñi *p̂ikwin* can hope for is that the two events will correspond 5 times every 19 years (3,5,3,3,5 years); the worst is that the two events will coicide only once in 19 years. Thus, the *p̂ekwin* will be wrong most of the time. The Hopi do not seek as great a degree of precision in this particular situation. Yet, the Hopi, too, must fail in the majority of their attempts to reconcile the solar and lunar years (calendars).

Second, ethnographic data indicate that the Pueblos had tally sticks and other record keeping devices (e.g., Cushing 1967; Stephen 1936) in addition to their horizon calendars and astronomically aligned features. However, there is little to indicate that they had a mathematical system sophisticated enough for long-term record keeping and for the interpolation required for accurate predictions of winter solstice—full moon coincidences. The lifetime knowledge of the *p̂ekwin,* for example, would be of relatively little value to his successor when the pattern shifted

from one sequence to another, as from once in 19 years to 11,8,11,8 years, or from 8,3,8 years to 11,8 years.

Third, the frequent failure of the priests to control, as expected, the sun and moon means that dissension must be common within the ceremonial societies and within the villages in general. The same was true historically. Indeed, such dissension appears to be endemic and may contribute to the factionalism which *is* endemic at so many pueblos.

Fourth, the usual lack of correspondence between the winter solstice and the full moon may help us to explain the shifting date of the Zuñi *Shalako* (Ellis and Hammack 1968), and this may also be a factor in the traditional existence of both "long" and "short" forms of the major ceremonies. These two forms, e.g., 8 days versus 4 days[14] are, perhaps, one means of reconciling the solar and lunar calendars.

Fifth, given the relatively infrequent coincidence of the winter solstice with the full moon, there is at work a "natural" check on priestly power. The inability of the priests to make accurate predictions all the time and the fact that this is due to the natural situation which is beyond their control (insufficient mathematics) places one check on the expansion of priestly power.

Sixth, this same lack of coincidence leads us to ask how or why people at Zuñi came to expect that the *p͡ekwin* would routinely "cause" these two events to happen together? This is discussed later.

Seventh, aside from the particular problem of the winter solstice - full moon coincidence, the Hopi and Zuñi priests have been generally successful in their observations and calculations. Furthermore, the respective systems have worked well as results of their behavior. This is, perhaps, sufficient to explain the persistence of the behavior, once established.

THE REALITY OF PRIESTLY "CONTROL"

The issue of the reality of priestly "control" of astronomical phenomena and events requires further discussion. From the Pueblo *emic* perspective, i.e., on the basis of informants' statements such as those regarding priests' duties and abilities, there is no question that the Pueblos "believe" their priests control the sun's movements and can also control weather through the use of proper ritual. Yet the same informants, as reported in the ethnographic literature, are obviously aware of their priests' fallibility in these matters:

> Nor may the Sun Priest err in his watch of Time's flight; for many are the houses in Zuñi with scores on their walls or ancient plates embedded therein, while opposite, a convenient window or small port-hole lets in the light of the rising sun, which shines but two mornings in the three hundred and sixty-five on the same place. (Cushing 1976:41)

If the Pueblos recognize that their priests make mistakes, why then do they state that they believe the priests control these astronomical phenomena and events?[15] Furthermore, why do they expect certain things to happen regularly, e.g., the winter solstice - full moon coincidence, when their grossest empirical observations indicate otherwise? These questions lead to others: How do priests obtain power? Or why does the group cede power to a few of its members? I have no definite answers, but two complementary hypotheses can be suggested here.

First, it is in the Pueblos' self-interest to believe in or to assume priestly competence. This permits the societies to function more smoothly than would be the case if every pronouncement by the priests was questioned or disregarded until it was empirically confirmed. Where central authority is weak,[16] as at Hopi, the priests are the political officials to whom, along with the clan heads (sometimes these are the same people), the villagers look for stability. It would be contradictory and self-defeating if the Pueblos did not cede competency and power to their priests until such time as this trust was violated.

Second, priestly power may often reduce the devisive effects of the endemic factionalism, although, in some cases, the priests may side with a particular faction (Titiev 1944). Usually, however, the head priests—*cacique, p͡ekwin,* etc.—are expected to remain apart from such mat-

ters (Lange 1959; White 1942). If a priest becomes too powerful, or obviously incompetent, the situation can be checked by the secondary officials, e.g., medicine society leaders, Bow and Rain priests at Zuñi, the katsina impersonators. Ultimately, charges of witchcraft can be levelled against those who do not conform to public expectations.

Perhaps more to the point is that, with the notable exception of the winter solstice - full moon problem noted above and the problem of prolonged adverse weather conditions such as the 1892-1904 drought at Old Oraibi, the Pueblo systems generally work. Regardless of the origin of priestly power, once in office, the priests have kept that power and expanded it through careful and successful manipulation of the system. They have learned to make accurate astronomical observations and to plan village activities accordingly. They are able to "stack the odds" for a good harvest in their favor: Successful crop production generally follows from their predictions and directives (Reyman ms.). Katsina dances and other ceremonies are scheduled so that food is distributed as needed, especially when supplies are low for the village in general. Good weather and careful calculations allow for a continuance of power and control. Empirically, such conditions occur often enough to reinforce the behavior. This provides a sufficient explanation for its persistence and is a good example of how "the logic of the irrational" often leads to an understanding of the underlying rationality for the observed behavior (e.g., Devons and Gluckman 1964; Spiro 1966). Priestly power and control simplify the decision making process, facilitate group cooperation, and alleviate, at least to some extent, intrapueblo devisiveness.

Finally, there is the matter of the process by which events such as the winter solstice - full moon coincidence come to be expected. The following is suggested as one possibility.

It could have happened that, at some point in Zuñi history, the *p̂ekwin* thought it possible to calculate the simultaneous occurrence of the two events. Perhaps he noticed that they coincided during a particular year. Given that the sun appears to stand still for 3 or 4 days at the solstice, the *p̂ekwin* may have thought it possible to correlate this standstill at the winter solstice with the appearance of the full moon. As noted earlier (see note 13), the pattern of coincidence varies with the years and with the number of days (^{2}) one allows for the events to coincide. If the *p̂ekwin* calculated the date of the solstice and allowed as many as ^{2}3 days as a margin of error, and did this during one of those periods when his calculations seemed to achieve maximum results—5 coincidences in 19 years—then the prediction and the expectation of coincidence may have found their way into the astronomical system. One such favorable period occurred from A.D. 1485-1534 (see Table 1). The next two years of coincidence would have been A.D. 1542 and 1550, although neither coincidence would have fallen precisely on the winter solstice; 1542 would have been one day late, and 1550 would have been two days late. The Zuñi may have even considered this shift to 8 year intervals to be a sign that their relationship with the universe had been disrupted, that harmony had been disarranged, by the *entradas* of de Niza (1539) and Coronado (1540-1541).

Nevertheless, during the period from A.D. 1485-1534, coincidence may have occured often enough for the *p̂ekwin* to predict it and for the people to have believed him. Heavy clouds, which are common in winter, could have helped the *p̂ekwin* by obscuring observations, thus making the situation seem ot occur more often than it actually did. In any case, the expectation became fixed in the Zuñis' minds to the point that problems arise when the the two events do not coincide. Finally, it is possible that the people now manipulate this expectation to make the *p̂ekwin* more aware of the limitations to his power (if this hypothetical situation seems fanciful—and it is—bear in mind the circumstances surrounding the arrival of Cortez among the Aztecs).

THE CORRELATES OF PRIESTLY BEHAVIOR

As we have seen, the western Pueblos have more complex astronomical systems than do the eastern villages. The two groups also differ in other ways, and these differences are often explained in terms of specific historical and environmental factors (cf. Eggan 1950; Ellis 1964; Fox

1967). The two levels of complexity in the respective astronomical systems may also be results of these same factors, particularly the environmental ones. Following Eggan (1950), I suggest that the eastern Pueblos, situated along the Rio Grande and its tributaries, a generally more favorable environment for farming and hunting/collecting activities than the more arid environment of the western Pueblos, did not require the more complex and precise astronomy found at Hopi and Zuñi. For example, horizon calendars are used in both areas, but they are more complex among the western Pueblos, i.e., topographic features are used to mark a greater number of days in the solar year. The Pueblos in both areas recognize many of the same stars and use them for timing ceremonial events; but the western Pueblos recognize more stars, use them in more ways, and strive for greater precision than do the eastern villagers. In short, the somewhat more marginal environment of the western Pueblos has, in part, given rise to a more elaborate system of astronomy in relation to adaptation than is found among the eastern Pueblos. The same sort of dichotomy is apparent in their respective ceremonial societies: In the West, the main function is rain-making, while in the East it is curing (Eggan 1950).

Table 1. Winter Solstice - Full Moon Coincidence, A.D. 1485 - 1534

Year	**Date of Full Moon**	**Years Between Dates of Coincidence**
1485	21 December	
1488	19 December	3
1493	23 December	5
1496	20 December	3
1501	24 December	5
1504	21 December	3
1507	19 December	3
1512	23 December	5
1515	21 December	3
1520	24 December	5
1523	22 December	3
1526	19 December	3
1531	24 December	5
1534	20 December	3

It may seem paradoxical that the West, with the more complex system, should be less successful than the East. I suggest that the solution to the paradox is found in the respective environments. The eastern Pueblos have a comparatively more reliable water supply than the western Pueblos. Thus, the farming system is more productive more often than in the western villages. A current analysis of production figures for both areas, though still incomplete, tends to support this statement (Reyman ms.).

Regardless of the particular system under discussion, however, one thing is the same throughout the Pueblo area: A significant amount of Pueblo behavior follows directly from the specific announcements of calendric dates by the sunwatcher. These calendars are used to structure day-to-day activities within the villages, and the priests have charge of the calendars:

> Wonderfully reliable and ingenious are these rude systems of orientation, by which the religion, the labors, and even the pastimes of the zuñi are regulated. (Cushing 1967:41).

At Cochití, the *cacique,* through the *nahí'ya* (war chief) originally, but now throught he *sí'at yoyo* (war captain; also *masewi*), schedules the major village activities on the basis of his solar observations: Seed preparation, field preparation, irrigation ditch maintenance, planting, harvesting, etc. (Lange 1959). At one time, the *cacique* even controlled the movement of Cochití residents in and out of the pueblo (Lange 1959:251). The *cacique,* operating through the *masewi,* mobilizes and directs the village work force.

Among the Hopi, the predictions made by the *ta´wa moñwĭ* of the coming winter solstice set into motion a wide range of activities in preparation for the event and the accompanying *Soyala* (winter solstice) ceremony. In terms of Hopi behavior, the same sort of things happen as the dates are announced for the other major ceremonies, e.g., *Pá´müriya, Powá´mu, Pá´lülükoñtĭ,* including the necessary farming, hunting/collecting, and ritual behaviors. Here, too, the priests have considerable power over the village labor pool.

There are additional behavioral correlates. A successful harvest often requires that new storage facilities be constructed; conversely, a succession of poor harvests will cause abandonment of these units, usually starting with the least accessible ones. Many of the astronomical data are incorporated into the pueblo, *per se,* in the alignment of architectual features. A window or wall may be constructed or rebuilt so that looking through it, or along it, the priest can observe the winter solstice sunrise, sunset or some other event (Cushing 1967; Ellis and Hammack 1968; Lange 1959; Parsons 1939; Reyman 1971, 1976a). Buildings are often constructed or modified in accordance with the needs of this priest-astronomer.

Thus, the priests organize the cycle of subsistence and distribution activities on which the Pueblos depend. If they do their work well, if good weather prevails, and if crop production is high, their power and prestige increase accordingly.

Limiting Factors. In times of drought or other natural crises, the priests make additional attempts to regain control of the situation (see below). The people follow this lead by expanding the area for subsistence exploitation to include a greater variety of econiches, the better to increase their chances for food production. Indeed, the Pueblos usually plant (and also collect) in a number of distinct econiches, and at different times in the growing season or year, apparently as a "hedge" against both adverse climatic conditions and possible calendrical errors by the priests (Bradfield 1971; Titiev 1938, 1944; see below for further discussion). The general increase in the area used for farming may also require that new water control systems be built and that outlying small house units be constructed. But the range of environmentally permissable modification in the cycle is quite narrowly circumscribed by the relatively brief growing season.

Other factors affect the success of the system. First is the often weak and decentralized nature of Pueblo sociopolitical authority, notably among the western Pueblos. Even in the East, however, the *cacique* is not omnipotent. In some cases, as at Taos, there is dual leadership which switches every half year (Ortiz 1969; Parsons 1936, 1939). Moreover, it is the war chief who carries out the *cacique's* pronouncements; he can dilute the *cacique's* authority and may, at times, undermine it. The various medicine societies also serve as a check-and-balance system so that power is often in the hands of priests rather than in those of *a* priest.

A second problem is the apparent endemic Pueblo factionalism noted earlier. As at Old Oraibi (Titiev 1944), Pueblo priests may find themselves leading factions or having their work disrupted by factional disputes.

Third, as the Pueblos became increasingly dependent upon farming, a better understanding of seasonality was necessary. In an attempt to increase predictive accuracy, Pueblo priest-astronomers apparently began to observe more and more celestial bodies and astronomical events. Efforts were made to record these observations and to correlate both the cycle of the individual motion and the correspondences or coincidences among major events within two or more cycles, e.g., the heliacal risings of Venus and bright stars such as Sirius, or the conjunction of the winter solstice with the full moon. Such things are difficult to do.

Fourth, the periodicity of events such as the winter solstice—full moon coincidence is long and complex in its operation. The Pueblos' lack of sufficient mathematical capability means that calculations for and predictions of such events are usually incorrect. The priests' failure to reconcile the data from their observations can affect the accuracy of their other predictions of seasonal changes and the concomitant optimal times for the various subsistence activities. The resultant

confusion may, for a time actually *decrease* the efficiency of their calendars as adaptive tools. In other words, in their attempts to improve the calendrical system and to expand their power base, the priest-astronomers observe and record a greater number of astronomical phenomena which they do not have the capability to integrate into the system. Thus, in their efforts to upgrade their control and increase their power, the priests may, instead, incorporate within the system the seeds of possible disruption and, worse, their own failure.

Fifth, relatively short-term climatic changes, such as a slight shift in the frequency and amount of summer versus winter rain, or drought, with the accompanying effects on arroyo-cutting and water table levels, are not predictable from Pueblo calendars. These climatic shifts also tend to affect adversely the periodicity of the seasonal changes which are predictable. In turn, the rate of environmental deterioration may increase, a situation begun, perhaps, by overexploitation of the land. The consequences of these changes, i.e., the reduced efficiency of the calendars in terms of farming and other economic activities, place enormous stress on the system. Such stress can precipitate village disintegration, as happened at Old Oraibi (Bradfield 1971; Hack 1942; Titiev 1944) and elsewhere.

Sixth, as conditions deteriorate, as the priests are unable to regain control, the entire community is affected. Where resources are communally controlled and utilized, or if intercommunity importance, these environmental changes, if unchecked in their consequences, can reduce sharply the carrying capacity of the land, This, in turn, disrupts the occupation of an area or even forces a major exodus from an entire region. The so-called "Great Drought" in the northern Anasazi area during the late thirteenth century is a notable example of this (cf. Bradfield 1971; Zubrow 1974, 1975).

SUMMARY

As long as the *cacique, p͡ekwin,* or other head priest performs well his functions, as described above, he commands significant respect and power. Priests whose behavior produces the desired results for the villages also receive considerable material benefits. Although these rewards vary from pueblo to pueblo, some of the common ones include the planting and harvesting of the priests' fields by the villagers, multi-year food supplies, meat provisions provided through special communal hunts, use of an "office" for priestly duties, one or more assistants, and allotments of land reserved for personal use; these last can be used to reward supporters and ceremonial participants (e.g., Cushing 1967; Lange 1959; Parsons 1936, 1939; Stephen 1936; Titiev 1944; White 1932a). Formerly, at Cochití, the people of the pueblo built a new house for the *cacique* when he took office (Lange 1959).

Should the priests fail, however, because of errors in their calculations, mistakes in their behavior, or adverse climatic conditions, they probably will lose most of all of their benefits. They may also be forced from office and can even be killed if they are tried and convicted of witchcraft. It is also possible, though less likely, for some of the same things to happen if they are too successful. Finally, priestly incompetence combined with bad weather have, in the historic past, been responsible for the dissolution of pueblos, most notably Old Oraibi.

THE PREHISTORIC CONTEXT AND CHACO CANYON

The issue of site abandonment is discussed in almost every site report for the Anasazi area (and for archaeological sites in general), and the reasons for the depopulation of entire regions, such as the San Juan River valley, are matters of long-standing concern to Southwestern archaeologists. In conjunction with these problems, researchers are also concerned with the processes of site fission, the subsequent establishment of new pueblos by those who left the "mother" site, and the nature of the relationships among the peoples of these towns (e.g., Kidder 1924). These problems have been of particular concern for more than 50 years to scholars working at Chaco Canyon; of special interest have been the relationship of the so-called "Bc" or small pueblos to the large town sites and the reasons for the abandonment of the canyon in the twelfth century (e.g., Bannister 1965; Bryan 1941, 1954; Hawley 1934; Hewett 1936; Judd 1954; 1959, 1964; Kelley 1966; Kelley and Kelley 1975; Kluckhohn and Reiter 1939; Reyman 1971; Vivian 1970). Several scholars have attempted to study these issues, in part, based on historic Pueblo data (e.g., Judd 1954; 1964; Titiev 1944; Vivian 1970; cf. Cushing et al. 1922; Reyman 1971, 1976a).

The major breakup of Chaco Canyon towns in the mid-twelfth century was probably caused by several factors. These continually fed back into the system to worsen an already deteriorating situation; eventually, Chacoan culture collapsed. Included among these factors are mismanagement of land resources, especially the overexploitation of the mesa-top vegetation, population expansion, cyclical arroyo-cutting, withdrawal of the Mexican *trocadores* and their economic support,[17] and intra- and interpueblo disputes, probably over resource allocations.

Space limitations prohibit consideration of all these factors. Thus, discussion is restricted to those aspects discussed earlier in this paper, namely, the interplay of environmental conditions and priestly behavior. Titiev (1944:98) suggests that:

> . . . the phenomena of Pueblo mobility and Pueblo decline are interrelated, that both are caused by the same sets of factors, and that they are more fruitfully studied as sociological rather than ecological problems.

I disagree with Titiev's assessment of the situation. Any social system must operate in response to its envirnoment, and an ecological study, in part, is concerned with the nature of this response, with the process of interaction. For example, Bradfield (1971) demonstrates that Titiev overlooked the significance of the 1892—1904 drought as a basic factor in the breakup of Old Oraibi.

The ecological perspective necessarily includes consideration of sociological problems. It is my contention that, in some ways the abandonment of Chaco Canyon followed the process involved in the disintegration of several historic pueblos, of which Old Oraibi is the best known example. I would also argue that the Chaco situation involved the sorts of priest—village—environment problems discussed earlier in this paper. It is toward the demonstration of this that testable hypotheses have been generated from the Pueblo ethnographic data, data which have already been considered above at some length.

Special considerations permit consideration of but two of these hypotheses. Current research (Reyman ms.), when completed, will provide a fuller understanding of the problems involved and will include the actual testing of the ideas mentioned here.

The first hypothesis is that, as the ecological conditions at Chaco Canyon and the surrounding environs worsened, the priests increased their efforts to regain control of situation. These efforts, in turn, affected the behavior of the Chacoan peoples, as reflected in the materials found at sites in the canyon. Thus, the test implications for this hypothesis would include the following archaeological data, in addition to evidence for environmental deterioration, *per se* (cf. Bradfield 1971; Bryan 1941, 1954). All of the activities listed below are, to one degree or another, directed by Pueblo priests.

1) Proliferation of astronomically aligned architectural features, most notably to intermediate points in the solar year (e.g., equinoctial sunrise and sunset, zenith transit of the sun), to the lunar "standstills," and to the heliacal rise/set position of additional bright stars along the ecliptic.
2) Sudden and widespread refurbishing of existing ceremonial structures, particularly those used for communal or interpuebloan rituals.
3) Subsequent expansion of existing water control systems and the concomitant development of new ones.
4) Increased utilization of outlying areas and more marginal farming sites, and the establishment of small, chronologically late house units in close proximity to these areas.
5) Increased utilization of nonlocal plant and animal resources, as reflected in trash remains at the major Chaco towns. This would probably be coupled with marked changes in the remains of local foodstuffs, including the gradual(?) disappearance of those local flora and fauna most sensitive to adverse changes in the local environment.
6) A short-term increase, followed by a decrease, in the number of contemporaneously used food storage rooms and storage facilities (e.g., bins, sub-floor pits).
7) Expansion of the interpueblo communication system, specifically in terms of those sites with possible significance as signalling stations or as checkpoints along trade routes (e.g., Kin Ya's, Tsin Kletzin).
8) Marked increases in the production of trade goods, presumably to be exchanged for food or, perhaps, for nonindigenous items such as macaw feathers which were thought to be ceremonially necessary for food production to be successful.[18]

Although incomplete, the current research (Reyman ms.) has provided some preliminary results which appear to confirm items 1, 2, 4, 7, and 8. It should be noted that other test implications can surely be suggested.

If the environmental conditions improved, it would have appeared that the priests had regained control. Consequently, one would expect to see the situation stabilize and for this stabilization to be followed, possibly, by a period of cultural advancement coupled with population growth. However, if one assumes that the priests' efforts to regain control failed, and that the entire situation worsened, as apparently happened at Chao in the early twelfth century, then one can argue for the decline of priestly power followed by the beginnings of village fragmentation. Here, again, the Hopi materials provide important data relative to the prehistoric Chacoan Anasazi (see, especially, Bradfield [1971] and Titiev [1938, 1944].

The second hypothesis is that the disintegration of the Chaco towns followed a process similar to that involved in the decline of Old Oraibi. A number of test implications can be specified for which one would expect to find confirmation in the archaeological record.[19] The issue of arroyo-cutting has already been resolved at Chaco Canyon (Bryan 1941, 1954). Thus, just prior to the abandonment of the canyon we would expect to find:

1) A further increase in the number of astronomically aligned architectural features, both in the towns and on the surrounding mesa tops, these dating to the end of the main occupation, *c.* A.D. 1150. These alignments, however, would not be as regularly patterned as the earlier ones, i.e., they would appear to represent an attempt to incorporate all observed data regardless of their importance or relationship to each other.
2) A sudden abandonment of large sections of existing towns, followed by
3) Increased occupation of outliers and the construction of new outliers
4) The incorporation into these outliers of astronomically aligned building features, but such that the total configuration represents a haphazard and very imcomplete calendrical system in comparison with the earlier systems at the major Chaco towns (Moenkopi and Hotevilla are specific examples used here as ethnographic models, especially their histories following the collapse of Old Oraibi).

5) A sudden collapse in the maintenance of the water control systems within the canyon and in the surrounding mesa tops, coupled with
6) The apparently simultaneous construction of water control systems at the outliers, these however—initially—of lesser architectural quality and complexity.
7) Significant decreases in the amounts and varieties of trade goods, both imported materials and items manufactured for export.

As before, this list of test implications is not exhaustive. There are almost certainly room occupation and utilization date which also reflect this disintegration, e.g., the abandonment of most food storage facilities, a marked decrease in trash deposition, etc. However, these data are are still being analyzed in terms of this hypothesis,[20] and I hope to report further on this and on other related issues in the future (Reyman ms.). Finally, any one or even several of the test implications listed here might also serve as test implications for other hypotheses. It is the combination of these which is significant in terms of my specific hypothesis and the entire issue of priestly power and Pueblo behavior.

CONCLUSION

Archaeologists continually seek fresh approaches to the study of their data, the better to explain human behavior. The ethnographic literature is a major source for information on historic Pueblo behavior and the people who are the descendants of the prehistoric Anasazi. This literature provides empirical data for the formulation of testable hypotheses relating to these groups. The preceding discussion demonstrates that the priests have the power to regulate much of Pueblo socioeconomic and religious behavior. The maintenance and expansion of this priestly power rest, in turn, on the priests' abilities (competence) and favorable environmental conditions. Errors made by the priests upset village life; when coupled with adverse climatic conditions, even relatively short-term ones, such errors can rend, irreparably, the fabric of Pueblo society. All of this suggests that the predictive dimension of priestly power must be considered and utilized; it provides a valuable perspective from which to study the ethnographic situation and Anasazi archaeological record.

NOTES

1) For instance, among the Hopi, the lunar months are reckoned and named, in part, on the basis of changes in the flora and fauna. The blooming of the prickly pear catus (*Opuntia* sp.) in March, because it signals the availability of this plant for food during a period when food is otherwise relatively scarce, is important to the Hopi; *ùshe müiya-uh,* "prickly pear moon" (Fewkes 1892; cf. Beaglehole 1937' Forde 1931; Parsons 1933; Stephen 1936) is the name for March.
2. Furthermore, I have examined the probable prehistoric Mexican origin for much of Pueblo astronomy, ceremonialism, and other complexes, as these are known from the ethnographic literature. And I have also considered the superimpostion of the various Mexican astronomical practices on the simpler, indigenous Ansazi astronomy (Reyman 1971, 1976b, 1978). As noted in these earlier reports, one conclusion of this research is that the statistically greater-than-expected correspondance between the Mexican and Puebloan astronomical systems and accompanying socioreligious complexes supports the hypothesis that Pueblo culture developed, to a significant degree, in response to Mexican influence and economic exploitation (cf. DiPeso 1968; Kelley and Kelley 1975). In short, as I have argued for some time, Mexico and the Southwest constituted an Interaction Sphere in which the respective groups existed in symbiotic relationships. For the Anasazi, this relationship developed mainly after A.D. 700-800, although there were earlier contacts between the

two areas (Kelley and Kelley 1975; Reyman 1971). Prehistorically, then, the northern frontier of Mesoamerica lay just north of the Four Corners region.

3. The term "priest" is used throughout this paper to refer to the head priest at a village, e.g., the *cacique* (eastern Pueblos) or *p̂ekwin* (Zuñi), or to the priest in charge of making and recording astronomical observations, e.g., *masewi* (Santa Ana, only) or *ta´wa moñwi* (Hopi).
4. Some of the variation may also be due to differential contacts with prehistoric Mexican traders—*trocadores* (see note 2, above, and Reyman 1971, 1976b, 1978).
5. Except at Santa Ana where the *masewi* (War Chief) makes the solar observations (White 1942). Santa Ana is unique among the Keres in assigning this duty to the *mesewi*.
6. *Cacique,* of course, is the Spanish term for the person who is generally considered to be the Town Chief (as opposed to the War Chief or outside chief). The native terms for this person are still used in the individual pueblos, although at Cochití the people commonly use an abbreviated version of the Spanish term—*"ka´sīk"* (Lange 1959).
7. Some Pueblos such as Zia and Taos consider the moon to be a male, while others like Islata and the Tewa believe it to be a female (Parsons 1939).
8. Lange's (1959) data indicate that the Cochití recognize months as lunar periods, but neither count nor name these periods in their traditional native astronomy, as we now understand the system.
9. There are few data on Laguna and Acoma, the other two western Pueblos. Astronomical observations and practices at Laguna seem to have lapsed some time ago (Parsons 1939). The data from Acoma are fragmentary (Parsons 1939) but appear to indicate that the system is about midway in complexity between the astronomical systems of the eastern Pueblos and that of Zuñi. This is consistent with the geographical location of Acoma, its history, and what we know about it in comparison to other Pueblos in terms of kinship, social organization, etc. (e.g., Eggan 1950; Fox 1967).
10. This is the generally accepted approximate date for the founding of Old Oraibi. Other locales in the Southwest such as Chaco Canyon, Mesa Verde, and the Wupatki area also contain evidence for solar calendars during this same general time period (Reyman 1971, 1976a, ms.).
11. The accuracy of these calendars and their effectiveness in terms of the subsistence systems should be obvious: The Hopi have inhabited many of their villages and maintained the integrity of their economic system for hundreds of years. In fact, Old Oraibi has been occupied continuously since perhaps as early as *c.* A.D. 900-1000. It appears likely (Bradfield 1971) that the 1892—1904 drought and other adverse climate conditions were the basic causes of the splitting of Old Oraibi in 1906.
12. It is not hard to understand how this might have happened. Hotevilla was settled mainly by people from Old Oraibi. In moving to Hotevilla, the priests probably lost sight of, or saw from a different perspective, many of the topographic features on which they relied for calendrical calculations. Furthermore, due to the split, some of the priests and the knowledge they possessed, including techniques of astronomical observation and recording, were probably lost.
13. Using Goldstine's (1973) data, a check was made for the coincidence of the winter solstice and the full moon. Several different results were obtained which varied depending upon the constants used in the calculations and especially as one changed the allowable margin of error, in days, used in working the formulae.

    1) Assuming that the date of the winter solstice is 21 December, but allowing ± 1 day to cover for those years when the solstice occurs on 20 or 22 December, the winter solstice coincides with the full moon once every 11 years then 8 years, then 11 years, etc. for up to 106 years; then there is a shift in coincidence to once in every 19 years for 247 years, then a shift back to the 11/8 pattern for 87 years,

then back to the 19 year interval, and so forth. The shifts occur mainly because of the rounding problem.

2) If we use the 21 December date, but allows ± days in thge calculations as a control for the shifting solstice date *plus* observational problems which may arise due to bad weather, then the pattern of coincidence for the two events usually follows an 8,3,8 years sequence within the 19 year cycle, then shifts to an 11,8 years pattern, then back to the 8,3,8 year sequence. The segments in this series can last as long as 209 years.

3) Using the 21 December date, but allowing for a ± of ► 2 days but ◄ 3 days, one finds that the frequency of coincidence follows an 8,3,5,3 year sequence for up to 266 years, then shifts to the 8,3,8 year pattern, and then shifts back again.

4) Combining all of the above possibilities, i.e., using the 21 December date with an allowable error 0 to ± 2.99 + days, the frequency of coincidence between the winter solstice and the full moon can occur as often as once in every 3 years—5 years—3 years—3 years—5 years in the 19 year cycle for up to 57 years (see Table 1); then the number of years between the cases of coincidence begins to lengthen.

Finally, the number of years in the various year counts cited above (e.g., 106, 247, 266, 87) is also variable, again largely because of the rounding problem. This situation obviously complicates further the efforts of the priests to achieve accurate astronomical calculations (for additional discussion of solar and lunar cycles, see the note by Born at the end of this paper).

14. For some ceremonies, the "long" form may last up to 10 days, while the "short" form may be held for only a day or two.
15. It has been suggested (John Fritz, personal communication, 1-22-79) that if nature is constant, then variation has to be explained by human error. Therefore, priestly error is a metaphor for human error in general. The point is well taken but needs clarification. In the Pueblo cosmology, gods control the weather and provide other benefits for humans. To secure good weather and these other benefits requires that the Pueblos obtain the gods' help through proper ritual. Bad weather, crop failure, poor hunts, etc. occur because the proper ritual and accompanying correct behavior (e.g., observance of food and sexual taboos) are not followed. Thus, good weather and other favorable conditions are considered to be constants; variations in them are seen as dependent upon human behavior with adversity due to human error. Since the priests are in charge of ritual, the error is generally seen as theirs. They system is reinforced and persists because the desired results follow often enough from the prescribed (and presumably correct) ritual behavior. Pueblo reasoning, in the situation, is obviously circular; but it is consistent with their belief system and "explains" the operations of the cosmos as they understand them. This is an excellent example of "the logic of the irrational" (Spiro 1966).
16. The lack of centralized authority, especially at Hopi and Zuni but also apparent elsewhere, may be a relatively recent development. It is not so apparent prehistorically. At Chaco Canyon, for example, the existence of large "ceremonial" structures—the so-called "isolated Great Kivas"—like Kin Nahasbas and Casa Rinconada suggests the development of inter-pueblo political control, perhaps externally imposed (cf. Frisbie 1978; Grebinger 1973; Kelley 1966; Kelley and Kelley 1975; Reyman 1971, 1978).
17. For a further discussion of this see Kelley (1966), Kelley and Kelley (1975), and Reyman (1971).
18. The issue of ritual paraphernalia needed by the Pueblos to ensure the success of their ceremonies is further discussed by Parsons (1939), Reyman (1971), and Stephen (1936), among others.
19. Obviously, failure to satisfy these test implications invalidates the hypothesis, i.e., that the abandoment of Chaco Canyon did not follow the Hopi example.

20. I have excluded here any consideration of the possibility that the Chacoan decline and abandonment were partially caused by changes in the interrelationship of the Chaco peoples with Mexican *trocadores.* Alternatively, the Chacoan decline may have precipitated changes in Mexico, especially as Mexican - Southwestern trade networks were disrupted forcing the Mexicans to look elsewhere for supplies of turquoise and other materials. In fact, I think that the Chacoan decline was hastened by a breakdown in economic relations with northern Mexican cultures (Reyman 1971; cf. Kelley 1966; Kelley and Kelley 1975).

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