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**MORMON SOCIOPOLITICAL DEVELOPMENT  
IN NORTHERN ARIZONA, 1876-1906:  
IMPLICATIONS FOR A MODEL  
OF PREHISTORIC CHANGE**

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**ABSTRACT**

Pueblo ethnographies are often used as sources of analogy in research dealing with prehistoric sociopolitical organization in the American Southwest. By relying on this implicit use of the direct historical approach, the organizational complexity of some prehistoric groups has been underestimated. It is suggested that the selection of ethnographic analogues be based on the question being asked by a researcher, rather than the cultural affiliation of the prehistoric group being studied. This paper focuses on the use of an alternative source of ethnographic information — the historic (1876-1906) Mormon occupation of the Upper Little Colorado region, East-Central Arizona. Information on Mormon subsistence-settlement systems is used to evaluate several assumptions of a commonly used environmental model that attempts to explain prehistoric change on the Colorado Plateau.

The direct historical approach is a commonly used method for interpreting many aspects of the archaeological record. This method of ethnographic analogy is normally restricted to areas where both cultural continuity and cultural conservatism are assumed (and sometimes documented) between present and past aboriginal groups, and has been extensively used in many parts of the New World, India, the Near East and Africa (Dozier 1970; Chang 1967; Tringham 1978:185; Fagan 1972:248-256; Kramer 1979:2; Ascher 1961). In these cases behavioral information on modern aboriginal groups is used as a direct analogue for reconstructing the activities and organizational structure of prehistoric societies. Thus, the behavioral correlates of aboriginal material remains provide the baseline for interpreting the archaeological record, and making inferences about prehistoric subsistence strategies, trade patterns, craft production and social organization.

In the American Southwest, Pueblo ethnographies have provided analogues for reconstructing prehistoric sociopolitical organizations on the Colorado Plateau for more than a century (see Longacre 1970a). A major assumption of these studies is that Pueblo societies are basically conservative, and that the organization of prehistoric Pueblos was fundamentally similar to those described ethnographically (Dozier 1970:204-205; Stanislawski 1973:120; Hill 1968:137). That is, the basic organizational components of

modern Pueblos (clans, lineages, moieties, etc.) occurred in one form or another among prehistoric societies. As most ethnographies characterize the political structure of Pueblo groups as bands (Service 1962) or egalitarian societies (Fried 1967), it has traditionally been assumed that the organization of prehistoric societies was also simple and egalitarian.

When applied without considerable caution, however, this method of analogy limits archaeological interpretations to a static model of the present that minimizes the organizational diversity which may have existed in the past (Binford 1967, 1968; S. Binford 1968; Freeman 1968; Hole and Heizer 1973). Implicit in the direct historical approach is the assumption that culture change in prehistoric and historic societies occurred at a fairly slow and gradual rate or that it did not occur at all. Otherwise the present could not be used as a direct analogue for reconstructing the past. The assumption that relatively little culture change occurred on the Colorado Plateau over the last 2000 years has recently been questioned. Upham (1979), Plog and Upham (in press), Wilcox (1976) and Wilcox and Shenk (1977:194) suggest that Pueblo ethnographies provide a detailed description of societies that have been influenced for centuries by population decimation, political subjugation, attempted religious reforms, and technological innovations resulting from Hispanic and Anglo intervention. Thus, while historic and modern Pueblos provide a great amount of information on culture change due to outside intervention, they may not be the most reliable analogues for reconstructing prehistoric Pueblo societies.

In addition, an increasing number of archaeological studies suggest that not all prehistoric societies on the Colorado Plateau were simple and egalitarian. Recent research on burial populations (Clark 1969; Upham 1978; F. Plog 1974:127-132; Reyman 1978; Frisbie 1978; Bez 1978), ceramic production and distribution (Graves 1978; Upham 1979; Upham *et al.* 1979; Hantman *et al.* 1978; Riley 1978) and regional settlement patterns (Judge 1979; Henderson 1979; Grebinger 1973; Martin and Plog 1973:297-307) suggest that complex political organizations existed in the prehistoric Plateau Southwest. These studies indicate that the political structure of prehistoric societies was probably quite variable through time and space, ranging from small egalitarian bands to more complex entities characterized by managerial personnel controlling and distributing land, labor, subsistence products and trade goods (see especially Judge 1979; Martin and Plog 1973:303-305; Grebinger 1973; Upham 1979). The potential for understanding the changes from mobile hunting/gathering bands to hierarchically arranged political entities provide Southwestern researchers with an important data base for expanding and evaluating current theories on culture change and evolutionary process. However, the implementation of such a research goal requires that we do not restrict ourselves to studying only the Pueblo present in order to reconstruct the Pueblo past.

There is no reason why we should necessarily assume that modern day descendants provide reliable analogues for directly interpreting past human behavior. Instead we should examine ethnographic sources as dynamic behavioral systems that can provide important information on many processes that underlie subsistence, settlement and organizational change. Viewed in such a framework, the use of ethnographic analogy should not be restricted only to the descendants of Southwestern groups, but to any relevant behavioral sources that provide information on the processes of culture change.

In such a manner, the archaeological problem being addressed provides the guidelines for selecting the type of ethnographic information to be examined.

By examining historic and modern behavioral systems as useful sources for generating models of culture change and evolutionary process, we can go beyond their present use as direct analogues for reconstructing specific activities and organizational units. In such a manner, problem oriented ethnographic research can be used to: 1) evaluate traditional Southwestern models; and 2) generate alternative models for explaining prehistoric change. For example, several recent studies have incorporated ethnographic information from California, Polynesian and New Guinea groups to generate nonegalitarian models for interpreting prehistoric settlement patterns and artifact distributions in the Southwest (cf. Wilcox and Shenk 1977; Grebinger 1973; and Graves 1978, respectively).

While alternative sources of ethnographic information are increasingly being used for model building and hypothesis generation, there is still a major source of behavioral information which has, for the most part, been neglected by Southwestern archaeologists. This includes the many historical records on Hispanic and Anglo farmers who colonized the Southwest during the 18th and 19th centuries. Many of these sources, such as diaries, church records and town histories, provide a wealth of information on behavioral responses to environmental fluctuations, the problems of practicing dry farming and irrigation agriculture, and the process of aggregation and sociopolitical change. As these are often critical variables in models used to explain prehistoric change, historic documents provide an important source for evaluating some of the assumptions underlying these models.

#### **Evaluating a Model of Prehistoric Change: An Historic Example**

The remainder of this paper is devoted to using one such historic source to evaluate the assumptions underlying a widely used environmental model that purports to explain a major period of prehistoric change on the Colorado Plateau. The model "explains" the process of aggregation, subsistence intensification, and increasing social integration among late prehistoric Pueblo groups as a result of a deteriorating environment. This environmental model will be evaluated by examining major subsistence-settlement changes involved in the evolution of one complex Southwestern society, the historic Mormon communities of the Colorado Plateau.

There are four primary reasons for selecting the Mormons for this comparative study. First, the processes involved in subsistence-settlement changes among both prehistoric and Mormon groups were very similar. As both societies were characterized by subsistence intensification, population aggregation, and sociopolitical changes, the Mormon example provides an excellent opportunity to critically examine the internal relationship of a set of processes that operated prehistorically. Second, the climatic conditions (summer dominant rainfall) that characterize the environmental model discussed above closely resemble the conditions that Mormon farmers faced when they colonized the Colorado Plateau. This allows one to critically evaluate what effect these environmental conditions had on subsistence, settlement and organizational changes

among Mormon groups, and what their effect might have been on prehistoric groups. Third, the Mormons attempted to establish a self-sufficient economic and political colony that was largely isolated from other existing Arizona settlements (Hantman 1978; Peterson 1967). Thus, the processes of intensification, aggregation and sociopolitical development, at least in the initial years of colonization, were more a result of internal growth among the Mormon church than an outcome of outside intervention (*i.e.*, the U.S. government dictating changes). Finally, the historic Mormon subsistence-settlement system was characterized by agrarian communities practicing dry farming and irrigation. Some aspects of this subsistence economy are very similar to the prehistoric subsistence-settlement systems of the area.

While the examination of behavioral processes among Mormon groups will not explain prehistoric change, they may provide us with some insights on how these internal processes operated in Pueblo societies. In such a manner, alternative models for explaining prehistoric change may be generated and evaluated using archaeological data. In addition, the Mormon example may be used to evaluate several assumptions underlying man-land relationships on the Colorado Plateau.

The remainder of this paper is divided into three major sections. In the first section the environmental model is briefly presented. The second describes the historical data on Mormon communities. The final portion of this paper focuses on the implications of the Mormon example and on the assumptions underlying the environmental model used to interpret archaeological data.

### **The Environmental Model**

One of the best known models which uses the environment to explain prehistoric change in the Southwest was developed during the 1960s and early 1970s by archaeologists pursuing research in the Little Colorado region, East-Central Arizona (see Longacre 1970b; Hill 1970; Schoenwetter 1962; Martin 1962). These studies indicated that major settlement, subsistence and organizational changes occurred in this area between A.D. 1000 and 1400. These changes included: 1) the increasing aggregation of families into large Pueblos along permanent drainages (Longacre 1970b:8-9; Martin 1964:224-225; Schoenwetter 1962; 2) a widening scope of social integration (Plog 1974:122-130; Hill 1970:89-90; Longacre 1970b:3); 3) the adoption of more productive corn strains (Plog 1974:134); 4) the development of irrigation and other water control strategies (Plog 1974:134; Vivian 1974; Plog and Garrett 1972); and 5) a greater diversity and quantity of exotic goods being associated with large Pueblos (Longacre 1964:204-205).

These changes were primarily attributed to a deteriorating environment produced by a major shift in seasonal rainfall patterns (see Hevly 1964; Schoenwetter 1962; Schoenwetter and Dittert 1968; Schoenwetter and Eddy 1964). According to this model a period of increasing spring drought and arroyo dissection began around A.D. 1000 and 1100 and had a serious affect on agriculture, especially dry farming, in the more marginal areas. Consequently, as a result of agricultural failure in these marginal areas, there was a widespread movement toward large permanent streams such as Silver Creek and the Little Colorado River which offered well watered, arable land. The settlement shift toward large permanent rivers produced a pattern of population aggregation in a

few settlements and increased the number of clan-like units incorporated within a village (Longacre 1970b; Hill 1970). Irrigation and other water control strategies were adopted along these water sources as other methods of agriculture, such as floodwater and dry farming, became increasingly difficult to practice (Schoenwetter 1962; Vivian 1974). These methods of subsistence intensification may have also developed as a response to the needs of increasingly large aggregates of people concentrated in a relatively few "optimal" areas (Martin and Plog 1973:297-301).

To summarize, the development of large Pueblos, an increasing scope of social integration, and the adoption of strategies of intensified food production are viewed in a causal model that stresses environmental change as the prime mover. In this model environmental change refers to longterm fluctuations in meteorological conditions, such as the shift from winter to summer dominant rainfall patterns, and not to annual or seasonal variation in rainfall and frost (see Schoenwetter 1962:192-194). While the model is appealing for both its elegance and potential explanatory power, it assumes a simplistic interaction between the environment and man. For example, is irrigation a likely response to environmental deterioration in the Little Colorado region? Is population aggregation along major drainages necessarily a result of a major environmental shift, or could it be caused by other behavioral processes? And what is the possible relationship between sociopolitical organization, irrigation, exchange and aggregation? Could changes within these subsystems have resulted without an associated environmental shift?

In order to better understand the interaction of these behavioral processes, and to answer some of the above questions, data will be examined on the development and expansion of historic Mormon communities located in the Little Colorado region. This discussion specifically addresses four processes: intensification, regional exchange, population growth, and sociopolitical development.

### **The Mormon Study Area**

This research focuses on the 1876 to 1906 Mormon occupation of an area southwest of the Little Colorado River. The study area is divided into two distinct ecological zones, the uplands and lowlands. The former, located in the Pinedale area, is characterized by ponderosa and juniper/pinyon vegetation and intermittent water sources. The latter and lower ecological zone, located around Silver Creek, is characterized by juniper woodlands and permanent streams.

Precipitation in the study area is biseasonal with relatively light moisture in the winter and heavy torrential storms in the summer. While annual and seasonal rainfall is quite variable, the lowlands normally receive significantly less rain than the uplands (Dunstan and Johnson 1972). This rainfall distribution has affected the subsistence practices employed in both zones. The lowland communities primarily practice irrigation farming, as permanent streams provide sufficient water to utilize fairly large irrigation canals, and rainfall is too sparse and unpredictable for dry farming (Palmer and Palmer 1978:8). For example, Silver Creek supplies enough water to utilize six miles of canals that measure six feet wide and four feet deep as well as two and one-half miles of canals that are three feet wide and three feet deep. These canals can irrigate

approximately 4800 acres of land (Bureau of Reclamation 1947:36-37). In the upland communities dry farming and floodwater agriculture are almost exclusively practiced, as rainfall is more abundant on the average, and permanent streams are absent (Palmer 1978).

### *Intensification*

Strategies of intensified food production, where an increase in labor input produced an overall increase in crop yields, were primarily initiated in the lowlands in the form of irrigation projects. The development and expansion of irrigation systems was a major strategy for increasing surplus production and augmenting the power base of local Mormon leaders. However, the maintenance of large irrigation systems demanded an immense labor input, which required an efficient managerial hierarchy capable of rapidly mobilizing and directing a large labor force.

The primary labor investment for major irrigation projects was not in the initial construction of the irrigation system, or even in the routine cleaning and maintenance of canals, but rather in the frequent reconstruction of canals and dams after major floods. The flow of the Little Colorado River is unpredictable and characterized by immense variation. Variation is seasonal, ranging from 69,000 acre feet in flood months to 244 acre feet in the dry months of June and July (Peterson 1973:177), as well as annual (Tanner and Richards 1977:11). While the flow of Silver Creek is somewhat more constant than the Little Colorado, it is still marked by considerable seasonal and annual variation (McClintock 1921:167).

Floods in the Little Colorado region are caused by two major precipitation cycles. One is characterized by snowmelt resulting from unseasonably high temperatures and occurs between November and April. The other consists of torrential rain storms which often occur between June and October (Bureau of Reclamation 1947:118). Both types of floods are capable of destroying dams, canals, fields and fences.

The initial Mormon colonization of the study area occurred in 1876 along the Little Colorado River with the settlement of four towns. Three of these towns (Obed, Sunset, Brigham City) were abandoned between 1878 and 1885, and only one, Joseph City, remains today. While disease, soil depletion and crop failures due to frosts and insects were important factors influencing the desertion of families from these communities, the major factor was the destruction of crops during spring floods and the intensive labor demand required to constantly repair dams and canals following these disasters (Peterson 1973:176-191).

Dam washouts were a common event along the Little Colorado River. For example: five dams were lost in five months at Old Taylor in 1878 (Fish 1893); eight dams were destroyed at Joseph City between 1878 and 1894 (McClintock 1921:141); two dams washed out at Sunset between 1878 and 1882 (Journal of Levi Mathers Savage August 25, 1878 and January 1882); two dams were swept away at Brigham City between 1876 and 1878 (Peterson 1973:19); and eight dams were lost at Woodruff between 1878 and 1886 (Peterson 1973:185). While problems with floods on Silver Creek were not as detrimental, there were six floods between 1878 and 1906 which seriously damaged dams, canals and fields (Levine 1977:13; Journal of John Standifird February 4, 1884 and February 21, 1980; Minutes of Quarterly Conference of Eastern Arizona and

Snowflake Stakes 1893; Palmer 1978; History and Settlement of Snowflake Area entry 1906).

Accounts of Mormon subsistence activities suggest that a great deal of time and effort was invested in maintaining irrigation canals and dams (see especially Peterson 1973:177-191):

The people had to work hard, on account of the hard times, their dams washing away every fall, and the scarcity of foodstuff. The settlements of Northern Arizona haven't paid any tithing up to the present (Journal of John Bushman December 1879).

Still the majority of the people were poor, living in a desert country. The labor on the ditches in the different settlements was enormous (History of the Snowflake Stake entry 1889).

From 1876 to 1894 the settlers (at Joseph City) spent as much time on dams and ditches, as they did on farms, houses and other work combined (Tanner and Richards 1977:48).

For a little community (Woodruff) we have a very heavy task in the shape of keeping up our big dam in the Little Colorado River in order to supply our land with water for crops (Journal of Levi Mathers Savage 1894).

While quantified data on labor input are scarce, one example indicates that 800 man-days of work were necessary to reconstruct the Joseph City dam in 1878. Unfortunately, this dam was swept away during a flood a few months after it was completed (Tanner and Richards 1977:43). It was not uncommon for dams to wash out several times in one year, thus greatly increasing the total annual labor input for a community (Minutes of Quarterly Conference of Eastern Arizona and Snowflake Stakes 1878-1906).

Two problems tended to exacerbate the labor requirements necessary to reconstruct irrigation systems after periodic disasters. First, the size of the early Mormon towns was small, normally ranging between 50 and 450 people (Hantman 1979), and only a relatively few able bodied people were available for the strenuous work of rebuilding dams and canals. Second, since floods often occurred in the early spring, there was often only a short period of time available to rebuild an irrigation system if crops were to be irrigated by mid or late May. This created a major manpower demand in early spring which created labor difficulties for individual communities.

The problem of rebuilding canals and dams so that crops could be irrigated by late spring and early summer was a serious one. Often irrigation systems were not reconstructed in time to water maturing crops and in those years disastrous yields were reported. For example, on February 20, 1891, the Joseph City dam was destroyed and despite an intensive labor investment crops were not watered until late June.

As they did not get the water to their farms until late in June, they raised but little grain, and as he had a large family they were in a strait to know where they could get the necessary means (Journal of John Bushman November 1891).

On February 21, 1890 a major flood washed away dams on both the Little Colorado River and Silver Creek.

As soon as practicable in the spring of this year work was commenced on dams and ditches which had been washed out by the floods in different settlements of the Snowflake stake (entry April 1890) . . . It appeared that people had labored hard to repair losses, but these labors had not been done in time to secure the planting of a full crop at Taylor, and next to nothing planted at Woodruff (History of Snowflake Stake, entry June 1890).

A flood washed away the Joseph City dam in the spring of 1882 which seriously reduced the acreage of crops planted.

... crops at St. Joseph (planted) late, in consequence of the great amount of labor put in the dam and ditches in spring, they having a hard struggle to get the water out upon the land, but what little crops they had time to put in were looking well (Minutes of Little Colorado Stake August 1882).

The mobilization of labor to quickly reconstruct dams and canals provided a major organizational problem for Mormon communities. Significantly, during the early occupation of the study area, the managerial hierarchy which administered the irrigation systems expanded in both size and authority.

The initial colonization of the Little Colorado region occurred under a sociopolitical system emphasizing an organization of communal effort and a policy of strict isolationism. This system, known as the United Order of Enoch, instituted communal control of land, labor and goods, and discouraged trade with non-Mormon settlements (Hantman 1978; Peterson 1973:92-112; Tanner and Richards 1977:51-63). The United Order stressed equality and uniformity, and each town was responsible for drafting a set of rules which implemented this policy. The political organization of these early settlements varied from committee rule, where decision making was spread throughout the entire community, as at Joseph City, to one completely dominated by one man, as at Sunset (Peterson 1973:112-122).

The United Order system was short lived in the Little Colorado region, effectively lasting only about five to six years (Leone 1972:124). Peterson (1973:102) suggests that a major reason for the failure of the United Order was its ineffective organization for administering irrigation systems. The Mormon political system is normally incorporated within the religious structure of the church. That is, there are three hierarchical levels of decision making, one at Salt Lake City (the Mormon religious and administrative capital), another at the regional or stake level, and the lowest managerial tier at the community or ward level. However, the political organization underlying the United Order essentially consisted of two hierarchical levels, Salt Lake City and the local community. While administrators in Salt Lake were important for directing major Little Colorado policies, as well as occasionally supplying food and goods to the colonies (Leone 1972:134), the great distance separating the two areas produced an inefficient system of decision making. It often took weeks or even months for messages to travel between the two areas (Journal of Jesse Smith; Journal of John Standifird) by horseback. In addition, the economic situation at Salt Lake was often unstable and assistance to the colonies was unpredictable (Hantman 1978; Arrington 1958:331).

As managerial policies took weeks to arrive from Salt Lake City, many of the major problems confronting Little Colorado settlers were locally resolved, especially in the case of local disasters where immediate administrative decisions were a necessity. The effectiveness of the local decision making organization, and its efficiency in implementing policies, proved to be an important factor for the survival of local communities. A major problem with the United Order system was that local communities were only nominally integrated at the regional level. The local decision making organization essentially consisted of a one level hierarchy, with each community resolving its own problems. Each United Order community managed all irrigation concerns within its territory, and was responsible for making any repairs on dams and canals (Peterson 1973:181). Water disputes between communities were arbitrated in Salt Lake City.

While individual settlements did on occasion cooperate with one another, such as when a surplus from one community was loaned to another (Tanner and Richards 1977:104), inter-community integration was relatively weak and the regional leadership so poor that no stable policy existed to help communities during periodic disasters. That is, there was no political organization capable of regularly mobilizing labor and providing assistance to stricken communities on a regional level under the United Order system. As the labor necessary to reconstruct an irrigation system was normally provided by the individual community, the migration of a few families from a town resulted in an increased burden on those individuals that remained. Eventually, if people continued to abandon a town, the working population decreased to a critical mass beyond which the maintenance of the irrigation system was impossible and the community was then totally abandoned (Minutes of Little Colorado Stake 1876-1887).

Beginning in 1878, as new towns were colonized on both the Little Colorado River and Silver Creek, a more integrated political organization developed in the study area. These towns were organized under the stewardship system where property was owned individually, wealth and status differences were recognized, and opportunities for economic ties with non-Mormons became possible (Hantman 1978; Peterson 1967:60-61; Leone 1972:124). By 1885 all the Mormon towns in the Little Colorado Region were organized under this political system.

With the development of the stewardship system, irrigation projects were managed by a regional two level decision making hierarchy. In each community practicing irrigation, the coordination of individual farmers for constructing and maintaining canals and dams was through a managerial organization known as the irrigation company (Peterson 1973:181-182; Leone 1972:134). This organization also arbitrated personal water disputes within a community. The irrigation company normally consisted of men who were ward (community) leaders, such as the bishop, and had considerable local status. Bishops had full religious and political jurisdiction within their own wards, but had no authority in any other ward and were subordinate to the stake president (Minutes of Quarterly Conference of Snowflake Stake 1892).

A second hierarchical tier, consisting of the stake president and his council, integrated several of these irrigation communities or wards into a larger political/religious unit, known as the stake. Unlike the stake president of the United Order who had little, if any, political power outside his own ward, the religious leaders of the stewardship system had considerable control over economic matters, especially those concerning irrigation. As stake presidents became involved in administering irrigation systems,

Stake gatherings increasingly assumed the character of staff meetings from which water policy and administration issued. One Danish settler uttered a truism when he remarked from the pulpit that all that was talked about in worship meetings was 'Vater Ditch! Vater Ditch! Vater Ditch!' (Peterson 1973:183).

The stake president under the stewardship system provided three very important functions for the Little Colorado communities. First, he could direct and mobilize labor from the entire region to construct new irrigation projects or rebuild dams and canals after major floods. For example, when the Woodruff dam was swept away in May of 1884 and 1891, the president dictated that every man in the stake would provide one

week of his labor in reconstructing the dam (Journal of John Standifird May 17, 1884; Minutes of Quarterly Conference of Snowflake Stake May 1891). There were a number of years when the Joseph City dam was rebuilt with labor mobilized from all over the stake (Peterson 1973:188).

Second, the stake president controlled the financing of major irrigation projects through a tithing system (which will be discussed in more detail later). For example, in 1890, 1891 and 1904, a total of \$6,450 was allocated by the stake president to assist in rebuilding the Woodruff dam (History and Settlement of Snowflake area; Minutes of Quarterly Conference of Snowflake Stake 1890, 1891, 1904). Finally, the stake president arbitrated water disputes between individual irrigation communities. A water dispute between Snowflake and Taylor in 1883 was settled by the president and a specially selected water committee (Levine 1977:32).

Briefly summarizing, irrigation in the lowlands was very labor intensive and was most effective when administered by a regionally integrated organization which could quickly mobilize labor, finance the rebuilding of canals and dams, and arbitrate individual and community water disputes. The regional decision making organization evolved from relatively autonomous communities to one characterized by a two tiered managerial hierarchy under which individual towns were integrated within a regional political structure.

#### *Exchange*

An alternative to labor intensive irrigation in the lowlands was dry farming in the uplands. This agricultural strategy required a much smaller labor input per unit of land. A potential field was cleared of rocks and plowed with a team of horses. The major labor requirement during the growing season was the occasional weeding and cultivating of plants with moisture retaining mulch. Fields were never artificially watered, but relied solely on rainfall and/or runoff from nearby hills (Lightfoot 1978).

While not requiring a very high labor investment in comparison to irrigation practices, dry farming strategies in the uplands were very susceptible to droughts and frosts. Major droughts which seriously affected upland crop yields occurred on an average of every two or three years (see Table 1). Crop damages caused by frosts occurred throughout the Little Colorado region, however, upland communities were normally the most seriously affected. While the destruction caused by frosts varied between Mormon towns, at least one community reported the occurrence of "killer" frosts in at least one out of every two years (see Table 2).

During years of continued droughts and/or destructive frosts by dry farmers' yields in the uplands were significantly reduced and food shortages often resulted (Minutes of Quarterly Conference of Eastern Arizona and Snowflake Stakes 1878-1906). Similarly in those years when spring floods destroyed fields and irrigation works in the lowlands, and when dams and canals were not rebuilt in time to irrigate summer crops, disastrous crop yields were reported (Minutes of Quarterly Conference of Snowflake Stake; History of Eastern Arizona Stake).

While crop failures occasionally occurred among both upland and lowland farmers, dry and wet years affected yields in each zone differentially, and failures rarely occurred in both areas in the same year. During those wet years when floods destroyed lowland irrigation works and fields, dry farmers in the upland zone often reported their highest

**Table 1**  
**Frequency of Major Droughts Among Upland Communities**

<b>Years of Serious Droughts</b>	<b>Sources</b>
1885-1887	Palmer 1978; Palmer and Palmer 1978:16; Minutes of Quarterly Conference of Eastern Arizona Stake.
1891-1894	Palmer 1978; Journal of Levi Mathers Savage; History of Snowflake Stake; Journal of John Standifird; History and Settlement of Snowflake Area; Diary of John Bushman.
1899-1900	History and Settlement of Snowflake Stake; Journal of John Standifird.
1902-1905	Palmer 1978; History and Settlement of Snowflake Area; Journal of John Standifird; Journal of Jesse Smith; Minutes of Quarterly Conference of Snowflake Stake 1902-1905.

**Table 2**  
**Destructive Frosts Reported for Little Colorado Region**

<b>Month and Year of Frost</b>	<b>Sources</b>
October 1880	Journal of John Standifird
September 1882	Journal of John Standifird
August 1884	Journal of John Standifird Diary of Frihoff Godfry Nelson
April 1885	Journal of John Standifird
May 1886	Minutes of Quarterly Conference of Eastern Arizona Stake
September 1893	Journal of John Standifird
September 1895	History and Settlement of Snowflake Area
April 1896	Journal of Jesse Smith
July, October 1897	History of Snowflake Stake; History and Settlement of Snowflake Area
June, September 1898	Journal of Jesse Smith; Journal of John Standifird
June, October 1899	History and Settlement of Snowflake Area
June 1901	Journal of Levi Mathers Savage
May, September 1903	History and Settlement of Snowflake Area
March, April, May, July 1904	History and Settlement of Snowflake Area; Journal of John Standifird
May 1905	History of Snowflake Stake

yields. For example, after the destructive floods of 1890 and 1891 which swept away dams, canals and fields along Silver Creek and the Little Colorado River, only a handful of crops were planted by the irrigation communities. However, upland dry farmers reported excellent yields for both these years (Minutes of Quarterly Conference of Snowflake Stake; History of Snowflake Stake 1890, 1891).

Conversely, when dry years seriously reduced the yields of upland farmers, lowland communities produced very good crops. Several accounts of drought years support this relationship.

- 1899* Irrigated lands in this stake have yielded very good returns, but in the mountain region a very severe drought has badly damaged crops (Minutes of Quarterly Conference of Snowflake Stake December 1899).
- 1900* Dryest year for 20 years, our people residing in the forest who relied upon rain and snow to mature their crops lost nearly everything in that line. Many springs and wells, heretofore thought to be permanent have failed, thus compelling some small settlements to haul drinking water several miles for months at a time. Even in some of the lower settlements where irrigation is followed there has been some complaints of a scarcity of water. Yet, in this latter class of settlements there have been very good crops raised (History and Settlement of Snowflake Area entry Winter 1900).
- 1902* A very heavy drought prevailed throughout this land during most of 1902. Approximately speaking there were no crops raised in our mountain districts, where it is not possible to irrigate, but those settlements along the streams raised very good crops (History and Settlement of Snowflake Area entry Winter 1902).

While several alternative responses to food shortages were tried, such as migration to more productive areas (Hantman 1978) and wage labor among non-Mormons (History and Settlement of Snowflake Area), the primary means of buffering uncertain crop production was the distribution of food among upland and lowland people. Three major methods of exchanging food existed among upland and lowland communities. Two of these were administered and controlled by the local decision making organization.

The first and simplest form of exchange was characterized by generalized reciprocity, wherein prosperous farmers loaned food to families in need and defrayed payment until after the next year's harvest (Palmer and Palmer 1978:7). During years of continued droughts and major floods, there is evidence of individual family surpluses being depleted (Minutes of Quarterly Conference of Eastern Arizona and Snowflake Stakes 1878-1906), and accounts of upland and lowland families who had sufficient surpluses loaning food (Diary of John Bushman November 1890; Diary of William Flake April 1880; Journal of John Standifird April 1880).

The second form of exchange was the institutionalized pooling and redistribution of food on an intra- and inter-community level. Within the boundary of a ward every full member of the Mormon church was taxed one tenth of his annual income. This tithe was payable both in money or in kind, that is, in those products locally raised such as eggs, hay, corn, wheat, beans, pigs, etc., or in labor (Levine 1977:130). The bishop presiding over each ward was responsible for collecting the tithe and centrally storing the products within the tithing house, which normally consisted of several granaries, root cellars, corrals and a scale (Leone 1972:131). Approximately one third of the tithing products were converted to cash and shipped to church officials in Salt Lake City (Leone 1972:134). The remainder of the tithes were used to support locally destitute families

and to finance public projects (Tanner and Richards 1977:104; Leone 1972:134). While a bishop had the authority to loan food to poor families within his ward, it is clear that major transactions involving more than a few families required the consent of the stake president or Salt Lake City (Journal of John Standifird April 24, 1884).

Under the stewardship system the stake president had the authority to allocate surpluses from community tithing houses to assist those wards suffering a major disaster. This repeatedly happened when floods destroyed fields and dams around Joseph City and Woodruff (Leone 1972:132). The development of a regionally integrated managerial organization, which could process information on resource productivity across the stake and allocate surpluses to those communities in need, proved to be another major advantage over the United Order system. As towns within the United Order were not integrated on a regional level, there was no political organization which could efficiently mobilize goods across the stake and regularly assist individual towns. I suggest that this is another major reason for the United Order's failure within the study area.

As mentioned earlier, a major function of the presidents under the stewardship system was assessing how individual communities were prospering and providing assistance to those in need. One major means of processing information on regional resource productivity was the quarterly stake conference, where the bishops of all the wards and the stake president assembled and discussed pertinent issues such as crop failures and food shortages.

The quarterly stake conferences served to advertise a season's particular strengths and needs on a town by town basis . . . Quarterly stake conferences — two of which took place during the most important times of the agriculture cycle, planting and harvest — served as regulators for the agrarian system. In the spring the region's disparities could be compensated for by rearranging the proportions of crops planted, and in the fall the region's entire needs could be collectively and accurately assessed and its surpluses redistributed, traded off in kind, or simply sold off to areas where shortage was most acute (Leone 1972:132).

Stake presidents could also process information on community conditions and insure that tithing accounts were properly settled by periodically visiting the wards in their stake (Peterson 1967:454). For example, Jesse Smith, president of the Eastern Arizona stake (1878-1887) and the Snowflake stake (1887-1906), continually traveled throughout his stake, assessing the strengths and weaknesses of various communities, especially during periods of major floods and droughts (Journal of Jesse Smith). During periodic visits, stake leaders often attended ward worship meetings where community problems were discussed with the bishop and townspeople. By continually visiting wards and participating in the quarterly stake conferences, the president was able to process information on differential production across the region and implement decisions on food redistribution within the stake.

The third method of exchanging food among upland and lowland communities was through the church financed and locally administered trading company, the Arizona Cooperative Mercantile Institution. Organized in 1884 and originally directed by the presidents of two stakes and nine bishops, the ACMI served as a wholesale outlet and retail store for the Little Colorado region (Levine 1977:29; Peterson 1973:136-147). Most communities initially had an ACMI branch store which served as a local trading center, where people often bartered locally grown products or labor as a means of

purchasing non-local goods (Leone 1972:133). A major function of the ACMI was buying local surpluses from families and tithing houses and freighting these goods to non-Mormon settlements for a profit (Krenkel 1970:338). In such a manner local perishable products were converted to cash.

Mormon families often traded local products or provided services (such as freighting) to the ACMI in return for net credits, which were later drawn upon during periods of crop failures. This credit was negotiable at all ACMI Branch stores and at most tithing houses within the region (Peterson 1967:252). Thus, the ACMI provided a local institution where farmers could "bank" surpluses during years of good harvests and receive food during years of low productivity. As the ACMI often loaned food and other goods to local communities during disasters (History of Snowflake Stake; Peterson 1967:245), it provided a major channel through which lowland surpluses were distributed to upland families during prolonged droughts or frosts, or conversely, upland products were distributed to lowland farmers during years of destructive floods.

As the ACMI board of directors were also the local religious and political leaders (Leone 1972:133), the trading company provided a major means of increasing the income flow of stake and ward decision makers, thereby augmenting their status within the Little Colorado region. The ACMI also provided an additional source of capital (along with tithing surpluses) for financing public projects, such as expanding irrigation systems, and supporting destitute families. Since the local managerial hierarchy controlled the redistribution of food from both tithing houses and the ACMI, stake leaders were extremely powerful in determining who was loaned food during periods of low productivity and who was not. Those individuals who were in poor standing with the church or were creating problems for local leaders often did not receive loans of food (see Journal of John Standifird 1884). Thus, while the tithing system and ACMI served to buffer local fluctuations in crop production among upland and lowland farmers and financed the reconstruction and/or expansion of irrigation projects, these institutions also functioned to support and increase the authority of the local managerial hierarchy.

#### *Population Growth*

The process of status differentiation and political development was accelerated by population growth, a factor often employed to explain intensification and sociopolitical evolution (see Logan and Sanders 1976). However, in the Mormon example, population growth appears to have been more a result of intensification and political development, rather than a prime mover in itself. During the first two decades of Mormon colonization, people were encouraged to settle within lowland communities and participate in expanding and rebuilding irrigation works. During these initial years a major function of the local decision makers was recruiting labor from Utah to work on irrigation projects (Minutes of Quarterly Conference of Eastern Arizona Stake December 1886).

Although populations for individual wards fluctuated, there was a general population increase for the Little Colorado region between 1876 and 1900. For example, the population of the Eastern Arizona Stake increased from 664 to 2200 people during this period (History of Eastern Arizona Stake). This population increase was both a result of immigration from Utah and natural population growth.

The combination of population growth in lowland communities and differential access to irrigable land (as will be discussed in the next section) eventually created a

strain on existing resources. A shortage of irrigable land forced some poorer families to move to the uplands and initiate dry farming. For example, as early as 1884 the limited quantity of irrigable land around Taylor compelled several families to migrate to the uplands and dry farm on a permanent basis (*History and Settlement of Snowflake Area*, entry 1884). There are accounts of lowland farmers having difficulties obtaining enough irrigable land to support their families, thus forcing them to move to the uplands (*Journal of John Standifird* December 26, 1889). While this shortage resulted in the construction of additional dams and canals (*History and Settlement of Snowflake Area*, entry 1904), the limited quantity of arable land and the fluctuating flow of Silver Creek and the Little Colorado River curtailed the amount of land which could be potentially irrigated (Peterson 1973:162).

The migration of poorer farmers to the upland communities and the gradual distribution of good irrigable land into the hands of a few prominent families accelerated the process of social stratification both within towns and between upland and lowland communities (see Hantman 1978). It appears that many upland families were treated as second class citizens (Peterson 1967:59-61), and that the political power base of the region centered around a few lowland communities such as Snowflake and St. Johns, where major administrative functions occurred. Significantly, population growth continued in these lowland centers, even though poorer farmers immigrating into the Little Colorado region increasingly settled in the uplands after 1890. Growth continued at Snowflake and St. Johns as the need for specialized services increased in these developing political-religious centers. These services produced a need for freight haulers (Peterson 1973:144-146), carpenters and stone masons (Peterson 1973:265), millers (Levine 1977:32), tanners (Levine 1977:32) and merchants (Levine 1977:37-40).

#### *Mormon Leadership Development*

The shift from the United Order to the stewardship system was associated with intensified food production, increased exchange, and population growth. I suggest these processes interacted within a positive feedback cycle whereby aspiring Mormon leaders initiated the development and expansion of irrigation projects and formalized exchange institutions. These strategies fulfilled a dual role for Mormon leaders: 1) they provided the surplus base to more efficiently buffer resource uncertainty; and 2) they were a means of augmenting their status and political position within the Little Colorado region. However the implementation of these strategies produced increasing demands on the existing political organization, stimulating the expansion of the local decision making hierarchy. The decision of Mormon leaders to intensify food production, recruit labor from Utah, and expand intra- and inter-community exchange networks, produced an increasingly more centralized sociopolitical organization, and the additional capital to support such an expanding system.

From the beginning Mormon leaders recognized the value of intensifying production, which supplied the surplus to buffer temporal and spatial uncertainty in resource availability. In addition, decision makers also recognized that irrigation could potentially increase the power base of those families controlling good irrigable land. Families who had access to sufficient quantities of irrigable land could initiate strategies of surplus production. This surplus base could be: 1) stored for use during periods of low productivity; 2) loaned out to people in need; 3) traded for non-local goods; and 4) converted into cash.

Sufficient surplus production to loan out goods and accumulate a significant amount of capital, especially cash, was a major means of facilitating a leader's role within a Mormon community. The loaning of food and goods created an obligatory relationship between donor and recipient, which was potentially important when favors were needed by an aspiring leader (see Journals of John Bushman and John Standifird for examples of loaning and obligatory relationships). One enterprising stake leader accumulated enough capital to become a "bank" which loaned money to local Mormon families. This institution later became the Bank of Northern Arizona (Peterson 1973:147).

An accumulation of capital was also a necessity to participate within a marriage network which linked together the powerful families of the Little Colorado region. While the rate of village endogamy was as high as eighty percent, there was an elite marriage network which crosscut communities and accounted for most of the exogamous relationships (Leone 1972:127-128). A man of sufficient status and wealth to obtain a wife from a powerful family would augment his own political position and, at the same time, strengthen his inter-community connections. This process of political development was enhanced by polygyny, which allowed influential men to cultivate social ties with several powerful families. However, the means to support several wives and their respective children was an important factor limiting the rate of polygyny. It is clear that poorer men were often hardly able to support one wife, let alone several spouses and numerous children (Peterson 1976, quoted in Hantman 1978).

The status and social connections of an individual were important factors considered when ward and stake leaders were selected. For example, during the floods of 1891, the people of Woodruff wanted a new bishop who was rich, enterprising and had sociopolitical connections across the region (Journal of Jesse Smith October 19, 1891). It appears that a powerful leader who had inter-community ties with influential families was a major asset for a ward, especially during periods of low productivity and disasters.

Given the relationship between good irrigable land and potential political power, it is significant that differential amounts of land were owned by lowland farmers. For example, when Snowflake was settled in 1878, land was to be equally allocated among all families. Each family was to receive a town lot and twenty acres of irrigable land divided into two ten acre plots of varying value (Peterson 1973:162). However, despite this policy of equality, land was unevenly distributed within the community. Polygynous households were granted an extra plot of land for each wife. In addition, polygynous men often appropriated extra lots for their minor children (Hantman 1978). As polygyny was considered the "badge of authority" in the Little Colorado region (Peterson 1973:245), those men who were influential initially received extra land.

The expansion of formalized exchange networks, such as the tithing system and ACMI, also accelerated the political development of Mormon leaders in the following four ways. First, by controlling the distribution of centrally stored products, decision makers could restrict the access of goods to only those individuals who conformed to both their religious and political policies. Second, as capital from the tithing system and ACMI were used to finance irrigation projects, additional surpluses produced through expanded irrigation systems were often reinvested through the ACMI. These investments (mostly through freighting) increased the dividends of the company's stock holders, who were also the local stake and ward leaders. Third, as stake administrators

received financial support through the tithing system for sociopolitical expenses incurred during office (Journal of Jesse Smith 1892), an increasing surplus base allowed decision makers to support more administrative specialists. Finally, differential access to irrigable land was reinforced by the ACMI which occasionally foreclosed debts by taking land from poorer farmers (Peterson 1967:248). As the ACMI was controlled by those men who had unequal access to land initially, this practice tended to increase the size of these large landholdings. Apparently this process continued into the mid 20th century, as four percent of the landowners in Snowflake controlled approximately seventy-two percent of the land by 1945 (Bureau of Reclamation 1945:144).

Briefly summarizing, the initiation of irrigation projects and the expansion of formalized exchange networks allowed local decision makers to more efficiently buffer regional resource uncertainty, and at the same time, augment their political positions. However, the implementation of such strategies placed an increasing demand on the existing decision making organization to process additional information on labor availability, water rights, resource fluctuations, and community needs. The organizational shift from semi-autonomous communities to one integrating communities within a regional political structure produced a more efficient managerial hierarchy that more effectively administered irrigation projects and redistribution networks. However, even after the initial shift to the stewardship system, irrigation systems continued to expand, population growth persisted, and intra- and inter-regional exchange increased. These processes produced an even more stratified and centralized political structure.

### **Implications of the Mormon Example**

The discussion of intensification, exchange, population growth and sociopolitical development among Mormon communities has a number of implications for the environmental model discussed earlier in this paper and I shall consider four of these.

First, is population aggregation along major drainages necessarily a result of a major environmental fluctuation? Recent studies on historic Mormons of the Little Colorado region (Hantman 1979) and historic Pima and Papago groups of Southern Arizona (Jewett 1979) suggest that the interrelationship between environmental fluctuation and human response is much more complex than most environmental explanations give credit. Most societies have a number of alternative options to respond to environmental fluctuations (such as diversifying their resource base, increasing exchange, and storage) and migration to more optimal areas, given the significant energy costs of relocating, is probably not as common as many Southwestern archaeologists have suggested (see Jewett 1979; Hantman 1979).

Population movement was, however, common among Mormon communities of the Little Colorado region (see Hantman 1979), and between 1876 and 1890, the population increasingly aggregated in a few, relatively large towns. This process of aggregation was, in part, a result of some towns recruiting a disproportionate share of the families from Utah, and attracting dissatisfied people from other Little Colorado communities. During the initial years of colonization, labor recruitment among lowland communities was crucial for undertaking irrigation farming, and those towns which recruited poorly often failed.

The two largest and most successful towns in the Little Colorado region were Snowflake and St. Johns. A major reason why these towns expanded and out-recruited nearby communities was their role as local stake centers. As stake centers they were the seat of the regional decision making hierarchy which consisted of the most influential leaders in the area. These leaders controlled the regional redistribution network, ACMI and the stake's labor force, which provided Snowflake and St. Johns with a major economic advantage over other nearby towns. Also, as stake centers these towns were more closely integrated with Salt Lake City and often received the greatest quantities of goods and money from the church (Hantman 1978). In addition to their greater economic stability, Snowflake and St. Johns offered non-agrarian specialists more opportunities to work as carpenters, store clerks, freighters and tanners.

Population growth in Snowflake and St. Johns is viewed as a feedback cycle, where their greater economic stability initially attracted farmers from both Utah and other towns in the Little Colorado region. This growth in turn produced a need for non-agrarian specialists who could provide increasingly more services for the expanding population. As these towns were not only political and religious centers, but also emerged as economic centers for the surrounding hinterland, the number of non-agricultural jobs continued to increase. Thus, population growth continued even when irrigable land became increasingly scarce around the stake centers.

What is significant about the growth of the regional centers is that they expanded at the expense of smaller, less successful communities. The initial settlement pattern of lowland communities between 1878 and 1880 consisted of a number of small settlements dispersed along the Little Colorado and Silver Creek. By 1890 a number of these communities had disbanded and the population had aggregated in a few large towns such as Snowflake/Taylor and St. Johns. While some of the people from unsuccessful towns left the Colorado region, many moved to the larger centers and became farmers when irrigable land was still available or in later years, skilled craftsmen and laborers.

Thus, the process of aggregation in the lowlands was not a result of a major environmental shift. The shift from a dispersed settlement pattern to a more aggregated one resulted from the interaction of social, political and economic factors.

Second, is the adoption of irrigation and other intensified subsistence techniques a likely response to a deteriorating environment? The massive labor investment necessary to periodically reconstruct dams, canals and fields, and the occasional crop failures due to floods, suggest that a subsistence strategy emphasizing irrigation would be difficult to implement during good years, let alone during a period of long term environmental deterioration. For example, during the initial construction of the Taylor dam and canals, several years passed before the irrigation system was fully productive. During this period Taylor farmers depended on stored goods, dry farming in the uplands and borrowing food from nearby communities (Palmer and Palmer 1978:1-9).

Given a major environmental shift and widespread crop failures, it is difficult to imagine that people of the Little Colorado region would choose to implement a subsistence strategy of irrigation farming. As irrigation systems may not have been fully productive for several years, a means of supporting laborers during this initial period of construction would have been necessary. If the region was experiencing a period of crop failures, then the source of food necessary to support large scale irrigation projects may not have been available.

A major problem with using the environment to explain the adoption of irrigation centers around the question of why people would attempt to implement this subsistence strategy when other less labor intensive strategies were available, such as those emphasizing hunting/gathering in the lowlands (see Hill 1970:90-96) or dry farming in the uplands. The American Southwest is characterized by an unpredictable environment, and seasonal and annual fluctuations in the harvests of domestic and wild resources are common (Martin and Plog 1973:329-330; Ford 1972:3-6; Glassow 1977:206). The uncertain environment of this area necessitates subsistence strategies that allow groups to exploit resources which fluctuate in their availability. While the environment potentially limits the kinds of subsistence-settlement systems which can adapt to this area, there are a number of alternative subsistence strategies that can buffer resource uncertainty (see Plog 1978). As the environment cannot be used to explain why one subsistence system is selected over another, other behavioral factors must be examined to explain subsistence-settlement change.

Third, can irrigation systems be developed and maintained by simple egalitarian societies in the Little Colorado area? Several studies suggest that small labor crews over a period of years can construct and regularly maintain extensive irrigation systems (Woodbury 1961; Adams 1974; Kirkby 1973; Earle 1978; Lees 1973). This research indicates that strong centralized political organizations are not necessary to manage large scale irrigation systems. However, the major factor requiring a managerial hierarchy in the Little Colorado region is not the initial construction or normal maintenance of irrigation canals and dams, but the reconstruction of such systems after periodic natural disasters. Given the need to quickly mobilize a large labor force, and to provide food from alternative sources during crop failures, it is questionable whether irrigation systems would remain productive without a managerial hierarchy overseeing labor and subsistence needs. The Mormon example demonstrates that irrigation communities managed by a weak decision making organization often failed, while those characterized by strong decision making hierarchies survived.

With the exception of Plog (1974:122-123), the idea that hierarchically organized political structures developed among prehistoric Little Colorado Pueblos was rejected, even though some archaeological evidence suggested that such an organization might have existed (Longacre 1970b:41-45; Hill 1979:79). The primary reason why centralized sociopolitical systems were not seriously considered by most investigators was that such an organization did not exist among historic Western Pueblo societies (see Hill 1970:78-81). However, archaeological evidence from burial analyses (Longacre 1970b:43-45; Hanson and Schiffer 1975; Hill 1970:79-80; Plog 1974:129-130), the differential distribution of exotic goods (Graves 1978; Upham *et al.* 1979; Hantman *et al.* 1978), and settlement pattern analyses (Lightfoot 1979b) increasingly suggest that stratified societies existed within the Little Colorado region by at least A.D. 1000 or even earlier. The implication of this sociopolitical organization are considered below.

Fourth, what is the possible relationship between sociopolitical development and prehistoric subsistence-settlement change? The Mormon example indicates that a feedback cycle existed between increasing sociopolitical development, subsistence intensification, regional exchange, population growth and aggregation. A major means of augmenting an aspiring leader's status and political position within a community was to initiate strategies of surplus production which provided the capital to implement political

maximizing strategies. In order for aspiring leaders to accumulate a surplus base, they expanded irrigation systems and participated within inter-community exchange networks. By expanding irrigation systems in the lowlands, recruiting a labor force, and developing a redistribution system that linked upland and lowland communities, Mormon leaders were able to increase their power base and provide a fairly effective organization for buffering resource uncertainty. However, the implementation of irrigation projects and formalized exchange institutions produced increasing demands for a political system capable of quickly mobilizing labor, controlling and distributing goods, and processing information on regional resource availability. This resulted in an organizational change from semi-autonomous communities to a regionally integrated managerial hierarchy.

The above feedback cycle provides an alternative model for explaining prehistoric subsistence-settlement and organizational change in the Little Colorado region. Given that decision making hierarchies were present in this region by at least A.D. 1000, the adoption of irrigation and increased regional exchange could have been strategies that were initiated to augment the status and political power of competing leaders. However, the commitment of some decision makers to intensify food production by initiating irrigation projects would have produced a more unstable economic system. Unlike dispersed settlement systems, which minimize seasonal fluctuations in rainfall, frost and wind by locating sites over diverse ecological zones (see Plog 1978), irrigation agriculture in the lowlands is a high risk strategy that is very susceptible to seasonal environmental variation. In order to reduce the problems of undertaking irrigation, decision makers would have had to recruit families from other communities, encourage population growth and develop formal exchange ties with upland settlements.

Increased aggregation along major rivers would result if some leaders were successful in stimulating population growth, initiating irrigation farming and undertaking symbiotic relations with upland groups. A managerial hierarchy that could mobilize a fairly large labor force and maintain exchange ties with outside areas would have produced a relatively stable economic system. By producing surplus harvests during good years, and gaining access to upland goods during bad years, large lowland irrigation settlements would be able to effectively buffer resource uncertainty. These communities would then be able to recruit people from small settlements practicing irrigation and/or dry farming, especially during periods of severe floods or spring droughts. Increasing population aggregation in large lowland settlements would have provided the additional labor necessary to keep expanding irrigation systems. This, in turn, would have provided a greater surplus base to enlarge the regional exchange network and support an increasingly larger and more complex sociopolitical organization.

In this model the processes underlying prehistoric change are viewed as a feedback cycle between intensified food production, increased exchange, and the expansion and centralization of the managerial organization. Although the interaction between man and environment is an important component of this model, environmental change is not used as a prime mover to explain why subsistence, settlement and organizational changes occurred. However, it is recognized that a major period of environmental change could accelerate the above feedback cycle. For example, if dry farming in the lowlands became precarious around A.D. 1000-1100, then it is possible that decision

makers situated on permanent streams could have increased surplus production through the expansion of water control systems. By providing increased economic opportunities through irrigation projects, these leaders could have induced dry farmers to settle in their irrigation communities. By recruiting families from failing settlements, decision makers could augment the local labor supply and intensify further food production by developing irrigation systems on a scale not previously possible.

The above model is only briefly presented here and many important theoretical questions are not addressed. Two crucial questions, for example, are why complex societies developed in the Little Colorado region and why irrigation strategies were not initiated until around A.D. 1000. These are major issues which are unfortunately beyond the scope of this paper. (However these questions have been tentatively addressed elsewhere; see Lightfoot 1979b.) The primary purpose of presenting this model is to demonstrate the potential for using alternative sources of ethnographic information to better understand prehistoric change.

To summarize, the Mormon example has suggested that several of the man-land assumptions underlying the environmental model are questionable and need to be reevaluated. For example:

- 1) Aggregation along permanent streams is not necessarily a result of environmental change, but can result from the interaction of political, social and economic processes.
- 2) Irrigation is not a likely response to a period of environmental deterioration and crop failures. Instead, the adoption of irrigation would probably have occurred during periods of relative environmental stability, when food was available to support the initial construction and subsequent rebuilding of dams and canals. Significantly, recent palynological and dendrochronological evidence suggests that climatic conditions around A.D. 1000 and 1100 were not deteriorating, but were wet and favorable for agriculture (see Euler *et al.* 1979).
- 3) In the Little Colorado region it would be extremely difficult for a simple egalitarian society to develop and maintain irrigation systems.
- 4) Prehistoric subsistence, settlement and organizational change were not necessarily caused by an environmental shift, but could have resulted from a feedback cycle between sociopolitical development, subsistence intensification and increased regional exchange.

The Mormon example has shown that alternative ethnographic sources can provide important information for archaeologists studying prehistoric change. Ethnographic and historical sources, such as on the Mormon occupation of the Little Colorado region, can be used to examine the interaction and feedback of key behavioral processes that possibly underlie cultural change. This information can be very useful for evaluating traditional explanations and developing more internally dynamic models of prehistoric change.

### **Conclusion**

Some traditional methods of ethnographic analogy are hampered by questionable assumptions which severely limit their use for understanding prehistoric change and

evolutionary process. The direct historical approach is constrained by assumptions concerning cultural continuity and gradual rates of cultural change. For more than a century the direct historical approach has been used to reconstruct prehistoric societies of the American Southwest. By relying on this method of ethnographic analogy to interpret the archaeological record, the organizational complexity of some prehistoric groups has been underestimated and the internal dynamics underlying cultural change have often not been considered.

It is suggested that a better method of using ethnographic information is through a problem oriented approach. That is, the selection of relevant ethnographic information should not be based on the cultural affiliation of the prehistoric people being studied, but the question being asked by the researcher. In order to demonstrate the utility of examining alternative sources of ethnographic information, a case example for the American Southwest was presented. Historic accounts of the Mormon occupation of the Little Colorado region provided a substantial amount of information on the problems of undertaking irrigation agriculture on the Colorado Plateau, the processes underlying aggregation and the development of complex sociopolitical organizations. This information was used to evaluate several assumptions of a sophisticated environmental model used to explain prehistoric change. The comparison of the Mormon example with the environmental model suggested that alternative ethnographic sources can provide important insights on the interaction of behavioral processes that may have operated in the past.

It is important that we begin to reevaluate the use of ethnographic sources in the American Southwest. By continuing to consider prehistoric and modern behavioral systems as isomorphic, the internal dynamics of cultural change will remain unknown and external factors such as environmental shifts and Athabaskan raiders will continue to be used as prime movers in the explanation of prehistoric change.

#### NOTES

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