

# Ancient Knowledge of the Chaco Canyon Anasazi

*by Richard D. Fisher*



*The Sky Island Granary Row Site  
The Paquimé Rosetta Stone  
C.E. 1400*



*Chaco Canyon Granary Row  
C.E. 1100-1150*

# The Last Great Mysteries of the Chaco Canyon Anasazi Full Circle ~ Paquimé to Chaco and Return

by Richard D. Fisher

*"During the last decade, archaeologists have come to the realization that the complex society of the Chaco Canyon Anasazi designed their architecture according to their cosmology" (J. Malville).*

*The Chaco Canyon Anasazi had no visible means of support. How did they survive? These Anasazi developed a sophisticated, though previously unrecognized, knowledge of the earth, particularly in relation to extreme fluctuations in yearly rainfall and its effect upon agricultural yields. I propose, therefore, that much of the Chaco Canyon architecture was specifically designed and constructed in response to this knowledge. The Chacoans were able to identify a virtually unknown blue-green algae which was common in the soil throughout the region and produced soluble nitrates and as such, could be exploited to produce fertilizer on which the entire agricultural system was based. Astronomical architectural alignments were clearly important, but a dependable and ample food supply, through ingenious growing and storage methods, was the foundation of Chacoan civilization.*

*"We are always happy, unless we are a little hungry"*

Felipe Torrez Cruz, Tarahumara Indian Runner, 1996.

The Chaco Canyon Anasazi identified and exploited a vast resource of cryptobiotic soil, which provided the fertilizer for their corn and required a vast storage capacity in systems of corn silos (kivas). It also supported the power to spread their Scarlet Macaw sun god religion and dominate the entire San Juan Basin with their unique culture for over two hundred years. The indigenous tribal groups and clans had known how to grow corn for over 1,800 years (Lyons). There is no evidence that they knew how to intensify production by using naturally occurring soluble nitrates (fertilizers) until the construction of Pueblo Bonito beginning in C.E. 800-850. It was not until the arrival of the Scarlet Macaw clan, however, that evidence for architecture which produces fertilizer emerges. It was this "green revolution" or more accurately defined "corn's golden era" of pre-Columbian Oasis America that has so captivated the imagination of scholars and the public with the enduring mystery of Chaco Canyon.

When I first started this project with the discovery of the Sky Island Granary Row site in the remote canyonlands of Mexico's Sierra Madre, I told the famous story of the conversation between Cortez and Montezuma. Cortez bragged, "My king eats from golden platters with golden utensils and drinks from golden chalices." Unimpressed, Montezuma observed, "I eat gold with my every bite." To the indigenous people of the new world, corn was gold and the most important thing in life. Just like everywhere else in the world, during that period, life was all about food. Fresh and nutritious food was very difficult to obtain, and without refrigeration, to store.

While archaeology worldwide has progressed dramatically with new scientific methods and techniques available during the last twenty years, Chaco Canyon archaeology has remained in a time warp during this innovative time period. Initially, I had no concern for archaeology and no reason to question Chaco's intractability. After analyzing the Sky Island Granary site, I began to search for the Hohokam and Anasazi long term grain storage facilities, and found none in the archaeological record. After five years of research, and based on the unpublished paper by Robert M. Adams, I came to believe that the numerous round structures identified as religious kivas were in fact, at least initially, exactly what one might expect them to be, corn silos.

As I interviewed hundreds of archaeologists from student researchers to retired ancient elders, I came to wonder why something that was scientifically so obviously a silo was still commonly identified as a religious room. These scholarly men and women were incredibly well educated and passionately dedicated to their science. It was just not logical that such dedicated professionals would be so deeply committed to the

idea that ninety or more percent of Anasazi architecture was "religious." Slowly, as I received the enthusiastic help from so many of the most well known archaeologists of today, I came to realize that the kiva, or round religious room, was the foundation established for Anasazi culture and archaeology over one hundred years ago. Quite simply, an enormous pyramid of empirical scientific work had been based on a very reasonable, logical, yet incorrect premise at the birth of this science. The religious kiva concept was such a good initial choice, that it has been able to withstand the weight of a hundred years of very careful scientific research.

In Anasazi archaeology today, however, all structures have become poorly explained "religious" construction. Based on an initial definition of the religious kiva, the basis and most important aspect of Anasazi construction the only way the field can progress is to declare virtually everything else as having ceremonial religious meanings. This, in and of itself, is not incorrect. In my view, however, ninety or more percent of everything the Anasazi did had a practical agricultural application first.

Anasazi scholar Ian Thompson observes, "There is no Pueblo word for religion, no word distinguishing religion from every moment of life from conception to death. Life and religion are the same." In my view, herein lies the fundamental conundrum. The large banks of Anasazi silos stored tons of corn. This is not inconsistent with religion. In fact, as the most important thing in life, these silos were the center of religious life for the Chaco Canyon Anasazi. To confound the issue, there are two types of round rooms, small and

large, at Chaco Canyon. My research has found that the small round rooms are for long term storage of grain and the large round rooms are essentially community ceremonial kitchens. The Chacoan religious structures were the platform mounds, which was what might be expected across North America during that time period.

I do not believe that Kachinas ever danced in the Chacoan kivas during the pre-Columbian era. I do believe that expansive ceremonies were conducted on platform mounds and "pyramids," much as in other major cultures of that era. I believe that these ceremonies focused on "sun god" beliefs as symbolized by the Scarlet Macaw. The kiva or earth goddess ceremonies occurred at a much later time period (C.E. 1275) when the matrilineal indigenous clan established dominance over the male dominated Sun/Scarlet Macaw clan(s).

It was not until after about C.E. 1275 that Kachinas began to hold ceremonies in what were formerly great kitchens or large corn silos outside of Chaco proper. As noted by Ian Thompson, there is no religious inconsistency in definition. In archaeology, however, this divergence in usage makes it impossible to resolve the intractable mystery of Chaco Canyon.



As the Tarahumara runner Felipe Torres Cruz points out and history confirms, happiness and the meaning of life for agriculturalists is fundamentally linked to every aspect of producing, storing, and consuming the food which is provided by God.

What I am striving to explain is how a fundamentally practical system of managing the food supply in Chaco Canyon and elsewhere translates into a sacred life-style and cultural legacy that endures to this day.

A chance interview with retired archaeologist Vorsila Bohrer helped me to understand that the cryptobiotic blue-green algae could be grown in the artificial aquatic environments such as Mummy Lake Mesa Verde. My perception of the so-called Hohokam "ballcourts" and the many other architectural constructions that I have identified, shifted, and the Anasazi puzzle that I have been working on for half a decade was completed. Vorsila Bohrer reported to me she had found a strange black material like "curls of old paint" in a natural depression in New Mexico. She had the material analyzed and it turned out to be dried blue-green algae. Instantly, with the realization that the fertilizer made in what I had been calling "sweet water mulching swamps" could be dried, pulverized and transported, in a basket for instance, the entire Chaco system became clear. As a result I have now named these architectural structures "fertilizer dehydration basins."

This naturally occurring resource allowed the Chaco Canyon Anasazi to fill their massive system of granaries, increase population densities and create monumental architecture that had a practical and spiritual use such as Pueblo Bonito, the hundreds of other Great Houses and the extensive "road system." With the surplus corn that they were able to produce, however, came increasing anemia and depletion of regional wildlife populations which provided the essential dietary iron, leading in turn to increased warfare and even cannibalism. As harmonious natural life styles were the religious priority of the indigenous non-Mesoamerican clans, the majority of the population rejected the sophisticated agricultural strategies, along with the complex and perhaps authoritarian social systems. The archaeological and oral record indicates that the allied indigenous clans drove the Parrot Clan farther and farther south until they were finally eliminated at Paquimé in about C.E. 1450.

While it has been very exhilarating to me personally, to make a strong, persuasive and comprehensive argument that the vast system of Chacoan "kivas" are actually a system of granaries and communal kitchens, it was even more deeply satisfying to have identified, with the help of Vorsila Bohrer, the basic mechanism with which fertilizer was produced from Mesa Verde to Guatemala in the pre-Columbian era. This "discovery" provides for the foundation for the development of all of North America's complex "high" civilizations.

Any culture that could manage an environmental resource like cryptobiotic soil to make the San Juan basin blossom, producing a huge surplus of golden corn, could rightfully claim that their knowledge came from God. With this ancient knowledge, the founders of Chacoan culture could persuade the in-situ indigenous clans to join them to develop what became one of the most mysterious and legendary cultures on the planet.

**Religion-Kivas -vs- Mounds** - The architecture of the mysterious and long-debated Anasazi people is marked by the round buildings called kivas. In general, "kiva" is the name given to round rooms of any shape and size. For the last one hundred years, archaeologists have insisted that the purpose of the kivas was religious. Notwithstanding I am prepared to argue just the opposite: that small kivas are 100% for grain storage and that large kivas are communal kitchens.

I believe religious ceremonies took place on platform mounds that have been identified as trash middens which are prominently displayed in front of many Great Houses. At Chaco Canyon and elsewhere C.E. 850-1275, approximately 40-60% of

the space is in round rooms, causing Chaco Canyon to be interpreted as a major religious center. My counter argument is that the Tarahumaras report that 90% of the meaning of life surrounds food and is totally integrated into their religious belief system. I say that with 40-60% of the architectural space in Pueblo Bonito and other Chacoan Great Houses dedicated to food storage and preparation, this control of the food supply would have given tremendous political power and a major draw for religious ceremonies. This proposal is completely consistent with all of the accepted archaeological evidence.

**Where did they come from and where did they go?** Following the Scarlet Macaws shows promise as a way to find the resolution of Chaco Canyon's origins. For the past seventy years many archaeologists have argued for "macaw" trade. This proposal, after years of intense investigation however, cannot be demonstrated. In fact, very little "trade" has been substantiated anywhere in the Anasazi/Hohokam/Paquimé with the possible exception of ceramics and shell trade. The Scarlet Macaws were arguably the personal property of Mesoamerican headmen or priests. "Among the initial clans to settle the Chaco landscape were the Parrot and Katsina clans" (Kuwanwisiwma). While the translation for the "Parrot" clan might be more correct as "Scarlet Macaw" clan, I believe, this Hopi report is absolutely correct. I propose that the Parrot (or Scarlet Macaw) clan represented the Mesoamerican patrilineal line and the Katsina clans represent the matrilineal indigenous lineages. The Chaco Canyon Anasazi were, according to archaeological evidence available today, a mix of a few Mesoamericans who intermarried with the local indigenous population. DNA testing of the "two high status" burials contrasted with the dozen or so accompanying dismembered burials found in Pueblo Bonito will aid in confirming or refuting this proposal. In fact, DNA testing of these two dignified Pueblo Bonito burials may very well resolve many mysteries concerning Chaco Canyon.

"The Hopi of today came from many directions including migrations from central Mexico. There were groups that were more like predators and who were not admitted to become Hopi. Hopi traditions are full of stories of movement due to crop failure, food shortfalls, and other kinds of threats to survival" (Emory Sekaquaptewa).

"The Chaco great houses projected a different sensibility. The finished product was very important. Skill and specialization were needed to do the fine stonework and lay the sharp-edged walls. I concluded that the structures had been built by men in the prime of life with a vision of something beyond daily life and the present moment. These were men who embraced a social-political-religious hierarchy and envisioned control and power over place, resources, and people... For me, they represented a desire to control human and natural resources. They were not about the Pueblo belief in the capability of everyone" (Swentzell).

Evidence indicated on departing Chaco Canyon they moved first to Aztec, then I suggest follow the Scarlet Macaws south to Wapatki, Point of Pines, Grasshopper and Kinishba ending up at Paquimé. There is also compelling evidence that they intermarried with the Great Sage Plain Anasazi. Matrilineal clans and their descendents remained to become modern Puebloan tribes.

**What distinguished the Chaco Canyon Anasazi from prior and post Indigenous groups?** The Chaco Canyon Anasazi brought with them the ancient knowledge of the Mesoamericans on how to find and exploit natural sources of soluble nitrates (fertilizer) which caused a "green revolution" or more accurately, a "golden revolution" in food production, primarily corn production. Although there is no directly evidence yet found, I propose it was the Scarlet Macaw clan that brought this ancient knowledge into the San Juan Basin for the first time. These agricultural innovations were the essential foundation for the Chaco Canyon Anasazi to culturally dominate the entire San Juan region. They were "farming" their entire environment including

plants which produced fertilizer that ultimately created a golden agricultural system which resulted in the Anasazi golden era.

They built distinctively large impressive buildings whose primary purpose was for the long term storage of vast quantities of corn. They had platform mounds for religious ceremonies. They had very distinctive agricultural strategies which allowed for increased population densities and surplus energy for labor. They built large numbers of round rooms for grain storage and food preparation. They utilized ingenious techniques to produce fertilizer. I suggest that with their surplus corn growing capacity, they developed large religious ceremonies atop the platform mounds in which tesquino/corn beer was consumed as a stimulant. These ceremonies attracted the clans from across the Chaco great house system. Some individual families had homes or quarters in Chaco central and dominated one or more great houses where most of the agricultural activities took place nearer the mountains, particularly the Chuska Mountains. Most, if not all, of the population participated in transhumance during the growing season often living far from Chaco.

**What is Transhumance?** From the original Greek and Latin, transhumance means quite literally "across ground." Some American archaeologists argue that this term is applied exclusively to the herding cultures of central Eurasia that follow their flocks seasonally from lowlands to highlands and back each year. I maintain that transhumance is the appropriate term for describing the widespread Native American practice of following a diversity of crops from lowlands where there are longer growing seasons, to highlands, where cold winter frost and heavy snows help control the ubiquitous corn pest, root cutworm. By having homes in both lowlands and highlands, the Anasazi were, for the most part, able to avoid a possible complete crop loss in any one year. Transhumance also provides that agriculture was done by virtually everyone, regardless of social status, and massive building projects such as Pueblo Bonito were constructed during the winter off season. This proposal helps resolve the major question of how large, complex buildings like Pueblo Bonito were constructed by the Chaco Canyon Anasazi. This proposal also explains within the context of known archaeology, how surplus food crops were grown and provided to the large seasonal work force needed for the massive construction projects as seen at the Chaco Canyon and its outliers.

"Food importation and a migratory segment of the population in the canyon seems the most reasonable, especially in view of the fact that early workers in the southwest such as Bannister found many Pueblos were nearly abandoned in the summer and early fall months: 'Last night Juan Jose told me that the pueblos were almost depopulated in summer, nearly everybody going out to the ranchos, where they live till September or October. But few remain in the pueblo. Even the cacique leaves also for this huerta.' (From Bannister's journal, April 17, 1882 as recorded by Lange and Riley 1966, p. 245)" (Loose, Lyons).

The Zuni people who perhaps numbered 3,000 inhabitants in C.E. 1700, most of whom lived in the central village of Halona:wa raised extensive corn crops spread over an area from present day St. Johns, Arizona, to the Zuni Mountains (50-70 miles) in what is now western New Mexico. Crops grew all over the territory of the Zuni's, and the people lived in the summers in widely separated villages. (Hart).

Associated with transhumance is a new proposal for the load carrying capacity of "110 pound loads over a one-way distance ranging from 30-150 miles" (N. Malville). "Maize excavated from the oldest section of Pueblo Bonito was grown in fields fifty miles to the west, along Captain Tom Wash on the Chuska Mountain slopes. Six cobs dated between C.E. 850 and the mid-900s, and one dated between 1088 and 1150. Although we had a small sample of cobs, none matched the soil water chemistry of Chaco Canyon" (Cordell). This Tarahumara, Zuni, and Pueblo ethno-

graphic information, indicates that corn was brought from throughout the San Juan Basin (approximately 100 mile radius of Chaco Canyon) to be stored in the Great Houses in the center of the Chaco system.

**Why did the Chaco Canyon Anasazi abandon the San Juan River Basin?** While drought and resource depletion were certainly contributing factors, the "straw that broke the camel's back" was anemia caused by a chronic lack of dietary iron. This became an unresolvable crisis when the increasingly rare and difficult-to-obtain wildlife populations were pushed back more than a three-days run from the Great Houses, making fresh meat too difficult to obtain.

**The History Channel asked, "Were the Chaco Canyon Anasazi peaceful Hopi ancestors or terrorist cannibals?" (Arts & Entertainment).** Cannibalism during the Chaco Canyon Anasazi time periods is a well documented yet controversial fact. As "wild meat," the best source of dietary iron, became increasingly rare, some of the Chaco Canyon Anasazi, who were directly descended by family lineage from the Mesoamerican male founders, may well have resorted to cannibalism to provide the absolutely required dietary iron. In turn, the descendants of the female indigenous clans may have rejected cannibalism and ultimately expelled those choosing high density Mesoamerican life-styles further and further south. This process began in approximately C.E. 1200 with widespread warfare, which is marked by a hiatus in the parrot importation and the burning of many villages, and continued with the introduction of Katsina religious concepts C.E. 1275-1300. This system wide event of warfare, I suggest, was a revolt by indigenous clans to push out the Mesoamerican descended clans. I propose to call this event the "Anasazi Reformation" in religion, social values, and life-styles. The Anasazi completely disappeared with the complete destruction of Paquimé in C.E. 1425-1475.

Hopi scholars relate concerning the cannibalism issue "There were also people who had traditions of human sacrifice, who were also not admitted into Hopi society" (Emory Sekaquaptewa).

**Chaco Anasazi - Political Organization** - Several models of political organization have been suggested. One model is a decentralized matrilineal society resembling the Hopi of today. The other is an extremely aggressive military style dictatorship that sponsored "terrorist cannibals." My research indicates that the Chacoans had a powerful motivator in the tonnage of corn stored in their extensive silo system. Those living within the Chaco system dedicated themselves voluntarily to the building of the massive great houses in Chaco Canyon proper. Neighboring groups may very well have received harsh warlike treatment, including human sacrifice and perhaps even cannibalism.

**Tesquino-Corn Beer Production. How could the Chaco Canyon Anasazi pay a willing work force to do all of the building?** The Chaco Canyon Anasazi demonstrated advanced knowledge in many fields, yet no evidence has emerged for brewing a very simple corn beer. Cultures throughout North America made corn beer with regularity during the Chaco time period. I do not know of any grain producing society on earth that did not at one time or another produce some type of alcoholic beverage. As far as I can discover, no study has been undertaken to investigate whether corn beer might have been made by the sophisticated Anasazi. Certainly, corn beer is very easy to make and in moderate quantities can be very beneficial for general health due to its high caloric and mineral content. Tesquino would have been much more potent for these people as the alcohol and sugars would have been enough in and of themselves to produce a mild or even advanced state of euphoria considering their normal low calorie, low sugar diet. The making of corn beer on a large scale for religious ceremonies would have given the Chaco "elites" tremendous power over distribution of

this "sacrament" to surrounding populations. The making of corn beer could very well be the overriding reason that Pueblo Bonito contains such a great number of small round rooms that could have been used as granaries. The making of corn beer may very well provide the avenue for research into the use of the large round rooms or what have been previously identified as "giant kivas." This is another point for investigation which will provide the ultimate answer for the Pueblo Bonito Great House as well as the entire Chaco Culture. (Disclaimer: To date, there has been no conclusive evidence for corn beer production.)

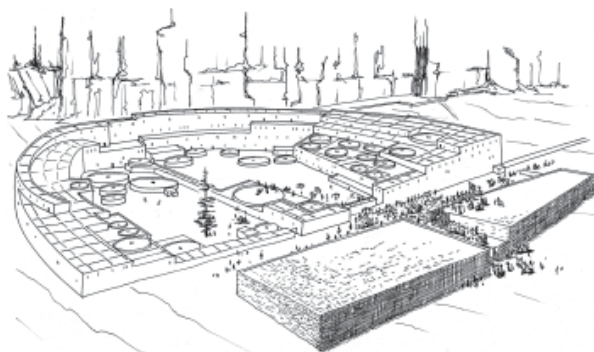
**Fertilizer Production-Challenge to Hohokam Ballcourt Theory** - David Wilcox, the authority on ballcourts and senior curator of anthropology at the Museum of Northern Arizona, stated in the June 2005 issue of Arizona Highways, "Well, the short answer is we don't know (what ballcourts are)". After seventy years, why is there no proof or even any strong and convincing evidence for ballcourts? The Hohokam oval might be called "useful monumental religious art" representing the female earth inviting the deposit of male fertile rain which is associated with lightning storms. From Tarahumara ethnographic reports, the earth is a human female or human females are the earth, not just representatives of these concepts. Equally, the sky is a human male or the human male is the same as the sky. The earth and the sky, being human, act like humans relating to sexual and reproductive activities, and equally, humans act like the "mother earth" and "father sky." This religious belief gives us the key to unlocking the mystery of the Hohokam ballcourts. In 1967, Edwin N. Ferdon, Jr. challenged the ballcourt theory noting that the original proposal by Emil Haury in 1935 was essentially that the "elongated depression" looked like a ballcourt, but that in the interim years to 1967 this theory was not supported by further evidence. Ferdon proposed that the elongated depression looked like a Papago "dance court." Since 1967 Ferdon's proposal has not been demonstrated. To date, these are essentially the only two proposals put forward. Yet it can be argued that if the Hohokam and others built elongated depressions that are essentially oval in shape and collect rainwater, that is exactly what the Hohokams intended to build. My proposal is based on Tarahumara ethnographic religious beliefs and scientific evidence concerning soluble nitrates contained in monsoonal rain along with intense lightning storms. I have built and tested scale models that reflect the shape of Hohokam "ballcourts" that have successfully demonstrated this proposal. I now believe that these oval topographical depressions are fertilizer dehydration basins. These are the Hohokam design for concentrating lightning rainfall, waste material and blue-green algae to produce soluble nitrates which could be delivered in either a liquid or dried form to the most desirable crops. I believe it is very likely that they used this fertilizer to enhance the sugar content in corn meant for brewing Tesquino (corn beer). This concept is worthy of further archaeological testing and debate. Simple stratigraphy test cores on unexcavated ballcourts should be sufficient to ascertain the potential for the proposal that the Hohokam used this shape to produce fertilizer.

**Mound Builders -Chaco Canyon Anasazi** - From Pueblo and Hopi ethnographic information the Chaco Canyon Anasazi have previously been assumed to be a culture whose religion was centered in the Kiva. I would argue that the Chaco Canyon Anasazi and others were a mound building culture like the rest of the highly complex cultures across North America during that same era.

Small "Kivas" or round rooms are granaries and large "Kivas" are corn processing rooms and perhaps are large communal kitchens used to prepare food and I believe corn beer "tesquino" for religious festivals. After C.E. 1275 Katsina religious beliefs transformed these round rooms into religious chambers in areas outside Chaco Central.

Noted archaeologist Thomas C. Windes records extensive mounds at the McPhee Pueblo (C.E. 860) which had an abnormally large outside midden, reaching more than three feet in depth. At *Casa del Rio*, located along the Chaco River, the multiple "midden" (platform mound) is more impressive: it reaches 16 feet above the surrounding terrain, and makes up an estimated 2230 cubic yards of material and is visible for miles around... in the mid-late 1000s, a highly visible and appealing type of agriculture came into vogue. Chacoan characteristics included core-and-veneer masonry, up to four stories, kivas built within the house construction, a giant kiva in a plaza or nearby, and a large mound or midden.

The map published of the Casa del Rio (In Search of Chaco, Noble/Windes, p19) shows an almost Paquimé layout of mounds, ponding areas, and potholes. The association of mounds and ponding areas is quite unique in the Anasazi area as far as I have been able to discover.



Other known Chaco era sites with high and extensive mounds are H-Spear (C.E. 1050-1150) (Mahoney) and Edge of the Cedars (C.E. 900-1150) (Hurst) where, Hurst observes, "Rubble mound rose more than 10 feet high with intact masonry rising into a second story." Still others are Guadalupe Ruin (Durand, Durand), Lake Valley, Willow Canyon, and Great Bend (Winds).

Archaeologist Dennis Gilpin (SWCA Environmental Consultants, personal interview 4/22/05) states at least four great houses have large middens which may have been mounds. These include the Chambers Great House, Navajo Springs, Tse Chi Zzi (Black Mesa) and the Bluff Great House, all dating to the same time period (C.E. 1050-1150).

I note that most archaeologists that I have interviewed agree that great houses from this time period were built to be seen from a distance. Many, if not most, of these great houses have what has been identified as a large "trash midden" in front. I question the Anasazi would build a great house that was meant "to be seen from a distance" and then put a trash mound right outside the front door. I suggest that these are platform mounds.

Since the predominant material in this region is sand, the platform mounds have eroded into rounded hillocks. There are some pottery shards scattered throughout the mound material as might be expected. I further observe that burials are commonly found in mounds and are very infrequently, if ever, found in kivas.

I was asked the question recently, why did they bury their people in trash heaps? My answer is, they buried their people in their religious structures which were ceremonial platform mounds, and as round rooms are granaries and food preparation chambers, there are few if any burials in these areas.

I would highlight that worldwide, humans bury their dead in religious buildings and not in areas where food is stored. Burials are a primary factor in analyzing the use of constructed space.

Recently, two pyramids have been discovered by archaeologists in central Chaco Canyon (Friedman, Stein, Blackhorse). This team has also identified five other pyramid sites that they believe to be Chacoan. I would suggest that these may more accurately be called "platform mounds."

# Kivas as Anasazi Granaries

## Ancient Anasazi Knowledge



*Granary Row Paquimé Culture*



*Granary Row Mesa Verde*



*Granary Row Pueblo Bonito Chaco. This bank of small granaries was built during the high rainfall years of C.E. 1100-1150. (Windes, Pueblo Bonito, p27)*



*Detail of Granary - Exterior 4" bench inset and ventilation shaft*

In my research, I have found the following sixteen reasons to question the currently accepted view that kivas are strictly religious structures with specific ceremonial uses.

1. The discovery and analysis of the new Sky Island Site with its extensive granary system in the Northern Sierra Madre of Mexico ultimately made it possible to resolve the Anasazi kiva or granary controversy.
2. The large number of "kivas" in Pueblo Bonito have always been suspect.
3. Yellow Jacket has almost two hundred kivas (Lekson, in *In Search of Chaco*, Ch 4, p25)
4. There are virtually no burials found in round rooms. Burials are never found in food storage areas. Burials are often found in religious structures.
5. There are virtually no artifacts found in round rooms. If round rooms are used for food storage, beer or food preparation, it would be expected that the food remains would have been consumed by humans or rodents so no artifacts would be found.
6. Hopi kivas are square and below grade.
7. Most Anasazi kivas are round and above grade.
8. The fact that some kivas have been found painted with the stepfret design and covered with soot might be expected from the usage that we are proposing.
9. After C.E. 1275 kivas have been found to be painted with religious murals. This indicates the change to Katsina religious practices.
10. Large kivas have rectangular raised masonry boxes. One of the primary explanations for these boxes is "sprouting vaults." I believe these vaults were used to sprout corn which is one of the primary steps in making corn beer. (the other proposal for the vaults is "foot drums.") While this is certainly possible, the sprouting vaults would be more consistent with the food and beer preparation use, for the large kivas. Due to the sprouting vaults "post wells" and firebox in large kivas, there is actually very little space for ceremonies.
11. Chaco Canyon "over engineering" is demonstrated by the many small kivas that have numerous exterior supporting walls. Archaeologists have described this as over engineering. If the kivas are actually granaries with tons of stored grain then these exterior walls are the proper support for the loose corn exerting outward pressure on the interior walls. This is also evident in virtually all sites where small kivas occur, such as Mesa Verde.
12. While all round rooms are being defined as kivas or religious chambers, there are at least three different types and many shapes and sizes in evidence. As far as I can find, there is no "religious" reason given by archaeologists as to the usage of the different types of round rooms. I suggest that each type has a specific use and that the variances within the types have specific practical applications. In fact, I can find no evidence of religious use prior to C.E. 1275.
13. Many "small" granaries/kivas and "Great Houses" were built to coincide with the high rainfall period C.E. 1100-1130. There is a significant cluster of construction dates for small kivas during periods of high rainfall or just at the end of high rainfall periods. It is likely that during periods of high rainfall, more grain storage space was needed and this led to a construction boom of Great Houses with "blocked in kivas" which I propose are the supporting structures for the huge silos across the San Juan basin.
14. Yellow Jacket had 192 small kivas. Sand Canyon had over 100 kivas and 14 drying towers. At Sand Canyon the ratio is almost 4:1 rectangular to round rooms.
15. Great Sage Plain (in southwestern Colorado near present day Dove Creek/Cortez) archaeologists strongly feel that kivas were used as living rooms "because of what we find in them" (Varien). I have no doubt that this is true for the time period of the abandonment C.E. 1280 (Kuckelman). I argue that at the abandonment, the stored corn surplus was long gone and as the most strongly constructed, most secure rooms in the pueblos, round rooms certainly were used as habitations and safe houses. The period of the abandonment demonstrates increased warfare as resources became critically depleted. Families that normally lived in fringe communities moved into the central and strongest pueblos of their relatives for protection, making living space a premium resource. With the silos empty and large population numbers living in centralized pueblos, without adequate food, the people left their most valued, non transportable household items sitting on the floor of the round rooms when they left. This proposal is consistent with accepted archaeological facts and equally it is good common sense, which is often missing when evaluating the vast number of round rooms as "religious kivas."
16. Without "ethnographic reports" there is no evidence at all to support the religious use of kivas prior to C.E. 1275, rather, I believe, there is extensive circumstantial evidence that these round rooms are corn silos, as might be expected to be found in a culture whose entire purpose and focus was on growing corn.

Chaco High and Low Precipitation		Comparative Estimated Construction Dates
High	930-950	6 kivas built-PB
High	1050-1080	5 kivas built-PB
High	1100-1120	27 kivas built-PB
Dry	980-990	
Drought	1130-1180	
Drought	1276-1299	

# Kivas as Anasazi Granaries

The bench width in many Chaco Canyon, Mesa Verde, and Great Sage Plain “kivas” as well as Paquimé granaries indicates a variety of uses which are consistent with dehydration towers and structures.



*Mesa Verde Multiple Granary Benches 3-6" wide*



*Kin Ya Chaco Outlier Multiple Granary Benches 3-4" wide*

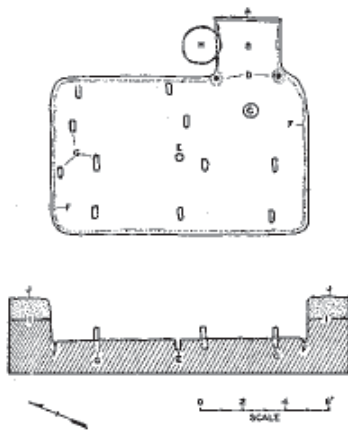


*Everything at Chaco especially Pueblo Bonito was done on a grand scale. Even the granary benches average 4-6" wider than other granary benches.*



*The bench width of 3-6 inches in the Sky Island Paquimé site granaries is consistent with the bench width in many Mesa Verde “kivas” or round rooms. (left two columns)*

*Hobokam Granary? below*



*The Hobokam had a less well understood structure that had a raised floor, fire pit, and schist stone risers; it is possible that this functioned in the same way as Chaco kiva/silos and Paquimé olla/granaries (Haury 1932).*



*The Lowry “painted kiva” is the “smoking gun” for a grain or meat smoke house. There were 25 levels of plaster excavated, and many of the layers had soot between them. The plaster and the floor should have been tested for corn pollen and residue. The drying racks are built into the pillars and are evident in some Mesa Verde sites as well. (Lowry smoker granary) (above 3 photos)*



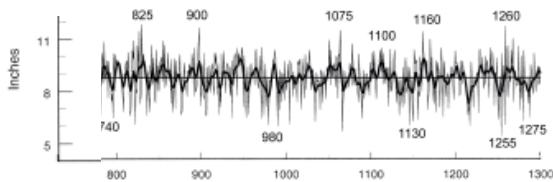
### **Kin Kletso**

From the available archaeological evidence, it appears that Kin Kletso, New Alto, and Casa Chiquita were essentially grain elevators. Very few artifacts were found in these buildings, and the supporting rectangular rooms were for support of the main grain silos. Other uses such as raw cob sorting, habitation, and ceremonial uses may be indicated for the rectangular rooms. "Massive storage units, not residences, were presumably used for feasts and/or redistribution of goods" (Lekson).

These two "silos" with their support walls were used for centralized long term corn storage. I suggest that each one of the Chaco Canyon Great Houses is the centralized storage structure for one clan who brought their corn to the central Chaco Canyon from throughout the San Juan Basin. According to the dates of construction, Pueblo Bonito, along with perhaps Una Vida, was most likely founded by the Scarlet Macaw family/clan. The subsequent eleven buildings were founded by direct descendants or relatives of the original Scarlet Macaw clan.

The primary use of all thirteen Chaco Canyon buildings was for long term corn storage and for festivals, based on this storage capacity. Again, according to the dates of construction, the subsequent buildings suggest that sons, grandsons, and great grandsons were perhaps the builders of the other named Great Houses.

As highlighted by my transhumance proposal, each one of the central Great Houses had one or more "outliers" associated with it.



"When the farms are small they build small silos and as the farm size increases they build progressively larger silos but continue using the small ones.

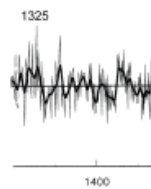
There is a problem with 'smut' which is a soil born mold that comes in on the grain. The silos are fumigated once per year to protect it from confused flower beetle" (Tanner).

This is consistent with the building phases of Pueblo Bonito and many of the Great Houses or, possibly, Anasazi grain storage silos across the San Juan Basin.



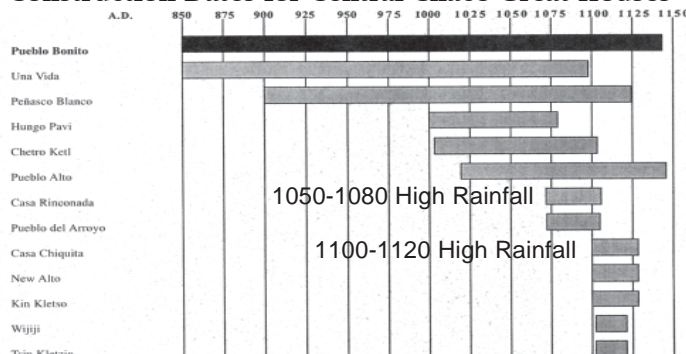
*Examples of Chaco "over-engineering."*

This support wall building was absolutely necessary to contain the tonnage of grain that was stored in these "kivas." This engineering support is absolutely consistent with outward pressure being exerted by liquid or loose grain. (above)



*This rainfall graph demonstrates the extreme variability of yearly precipitation. The Anasazi of the San Juan Basin had to have long term corn storage for social stability. Any group with such storage capacity would have had a significant competitive edge over neighboring groups (Van West)..*

### **Construction Dates for Central Chaco Great Houses**



*Permission granted Russ Bodnar.*

### **Additional Dates**

Wallace 1045-1108  
 Aztec 1051-1135  
 Salmon 1068-1116  
 Lowry Pueblo 1086-1170  
 Wupatki 1106-1215  
 Edge of the Cedars 1109-1215  
 Bluff 1111  
 Dominguez 1123  
 Ida Jean 11249  
 Escalante 1124-1138  
 Sand Canyon 1200-1277  
 Point of Pines 1207-1297  
 Kinishiba 1241-1366

# Fertilizer Production

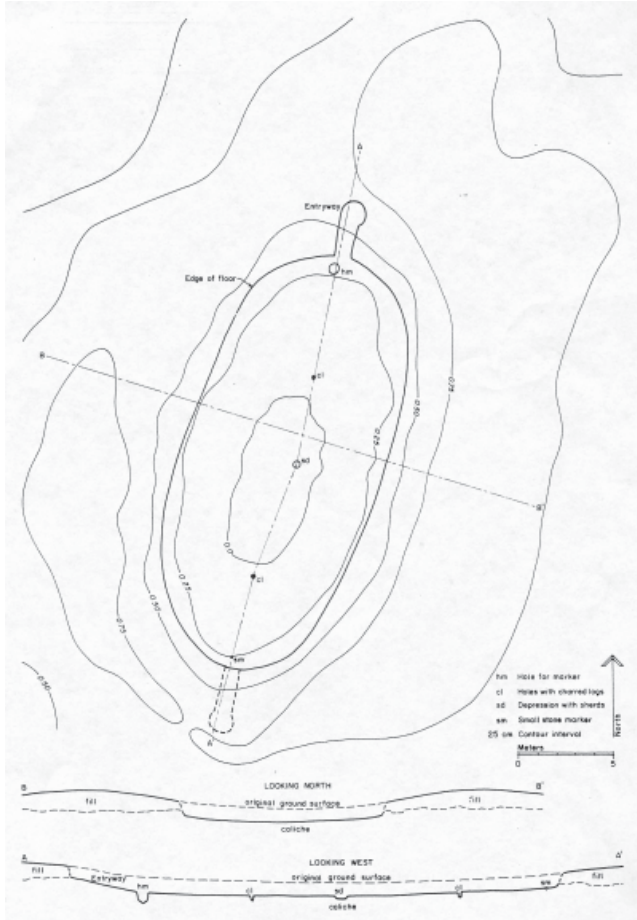
## Six Ancient Anasazi - Hohokam - Paquimé Structures



*Kin Ya Chacoan Great House and road may provide the break through link between fertilizer, corn growing field design, and long term storage. Note the very distinctive Chacoan "road" that intersects the rim around the Kin Ya "island." I propose this site be tested as one great corn field which used substrate "irrigation" and infusion of soluble nitrates produced by the surrounding cryptobiotic soils. (top left) Permission granted Adriel Heisey.*



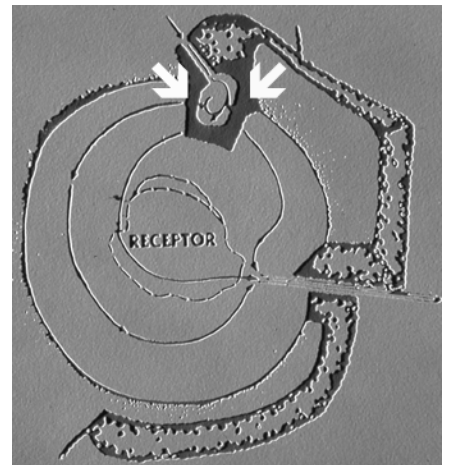
*Permission granted Adriel Heisey*



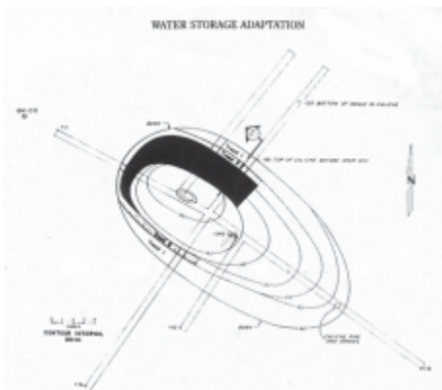
*The use of Hohokam fertilizer dehydration basins (ballcourt) was contemporary with the Chacoan era C.E. 800-1150. Architectural constructions and methods of producing fertilizer was an integral part of Anasazi, Hohokam, and Paquimé culture during this entire era regardless of geographical location.*



*Wupatki "Ballcourt"*  
*I suggest this is a female rain receptacle and that the area between the walls was used for production of high sugar content corn. (above)*

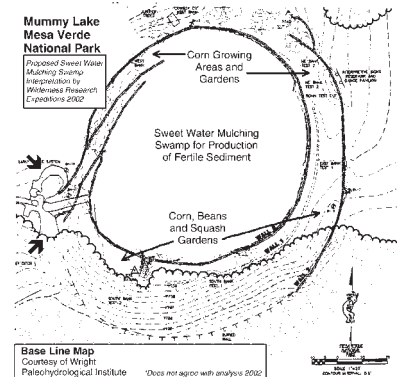


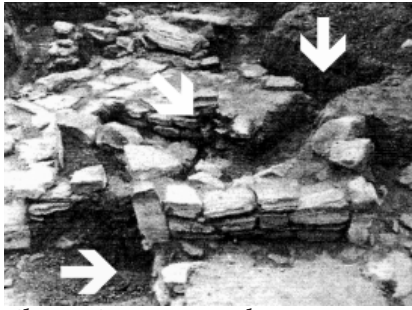
*Small court at Snaketown*



*The Paquimé "cleaning" system closely resembles the Mesa Verde Mummy Lake "Early Intake" system. This intake box is probably used to automatically mix and inoculate the incoming water with cyanobacteria and/or waste material or manure to produce a mixture of nitrogen rich water with which high volume, high sugar content crops were hand watered or the sludge could be dehydrated, stored, or transported as needed. (left)*

*Hot Wells Storage Basin with test trenches (Vernon L. Scarborough, 1988)*





*Chaco Canyon Headgate*

The three tiered Chaco Canyon triple box headgate is a design which can be used for adding waste material to irrigation water to produce soluble nitrates or fertilizer for the system of fertilizer dehydration basins. This closely resembles the “gate and pool” system found at Lefthand Canyon by Professor Neely. Contrasting this observation, R. Gwenn Vivian proposed that the three boxes were built at different time periods early to late.



*Courtesy Kate Bauer.*

All kivas are not created equal. This Casa Rinconada “kiva” was clearly not a ceremonial chamber. Its designs indicate it could be a fertilizer creation chamber or perhaps even a storage unit. Clearly it does not fit the profile of a religious chamber.



*Chetro Ketl, south wall.  
Collection channel for waste materials and soluble nitrates.*

## Fertilizer Anasazi - Hohokam - Paquimé

One of the greatest secrets of Chaco Canyon archaeology is that these people have no visible means of support. Grid gardens have been proposed but I intend to propose that even these limited agricultural enhancements are now in question. Even if grid gardens mapped by Vivian, Potter and Kelly were accepted they would only cover an area of 72.9 acres within the National Park. This would have supported only 82 people, while the population of Chaco is estimated up to 6,000 people (Loose). Further Vivian and others make no allowance that the “grid gardens” would have been in use for up to 200 years and there has never been any formal proposal for fertilizer accepted by archaeologists.

I began to research the fertilizer production of the Anasazi when the Tarahumara Indians reported that fertilizer was absolutely required for agriculture. I reasoned that if the Tarahumaras required fertilizer then the Anasazi, Hohokam, and Paquimé cultures would also require high quality fertilizer. Beginning with ethnographic evidence of the Chinapas (floating gardens) used by the Aztecs, I began to investigate the potential use of water, reservoirs, wells, and ponds for creating fertilizer.

Diane Rushford of the Tuzigoot National Monument indicated the first opening concept for producing fertile water when she told me “agriculturalists can hear corn grow when ionized rain comes from thunder and lightning storms.” She made the point so strongly that the concept followed my thinking for years and initiated this idea of “natural sources of fertilizer” for the Anasazi/Hohokam/Paquimé cultures.

What I discovered was a major breakthrough in the archaeological analysis of virtually all of the pre-Columbian cultures associated with Mesoamerica, including the Anasazi, Hohokam, and Paquimé.

The first key was the explanation of Mummy Lake where Ken Wright of the Paleohydrological Institute provided the basic archaeological data to support a soluble nitrate collection pond and surrounding walled garden.

The second breakthrough was for reinterpreting the usage of Hohokam ballcourts which I interpret as the architecture in which the Hohokam gathered fertile summer rainfall and mixed in other components to make liquid fertilizer.

The third, and for me the most important triangulation, was the mysterious pools on the agricultural construction of Lefthand Canyon provided by James A. Neely. I interpret these pools as being the mixing ponds for making the liquid fertilizer.

I also consider the Chaco Canyon well which is much too small to be a religious “kiva” and is not the standard shape and design for a corn storage silo/round room.

The Chaco Canyon “motes” have been an archaeological enigma. I suggest that the one along the south wall of Chetro Ketl has human waste collection compartments, and that this fertilizer was collected and then mixed in the “multiple headgate” to feed the system of fertilizer dehydration basins in the Chetro Ketl field.

R. G. Vivian has proposed that the Chaco Canyon “multiple headgate” with its three progressive boxes was constructed during three successive time periods. I counter with the proposal that the multiple headgate boxes were built as one unit and used to create a mixing or stirring motion as the water poured from one box to the next before entering the fertilizer dehydration basins. The water would have been inoculated with waste material and cyanobacteria to create liquid fertilizer.

The Paquimé well contained two whole bison and many sacrificial birds. Such a very rich mix of water and decaying meat would have produced a very valuable liquid fertilizer.

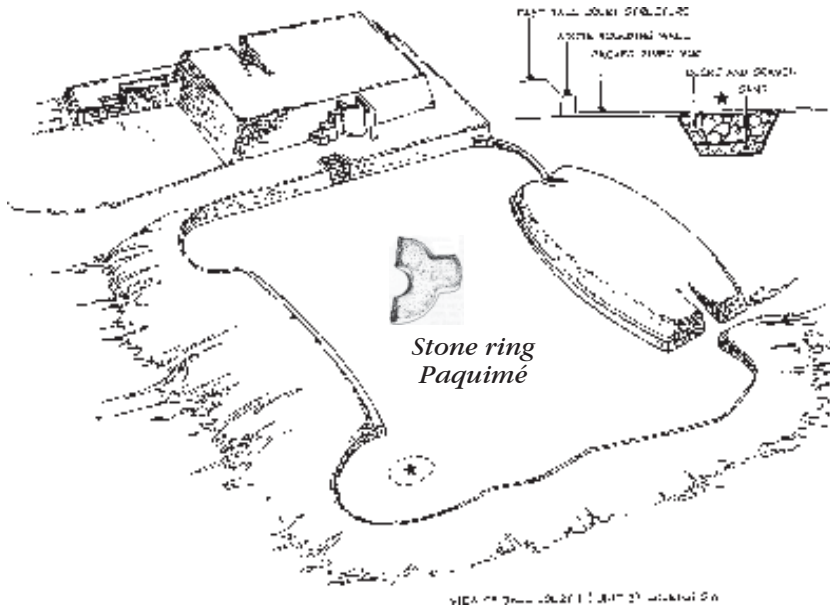
The Paquimé cistern closely matches several features of the Mummy Lake, Mesa Verde early intake system. This “intake box” was probably used to mix waste material and cyanobacteria to create liquid fertilizer in the cistern.

And finally the entire Paquimé site has many “water features” that would clearly have been for ponding gray or waste water. As a ceremonial site, many people would have arrived for festivals bringing with them valuable human fertilizer. Some of the activities on the mounds would also have produced waste material that when mixed with water would have produced liquid fertilizer.

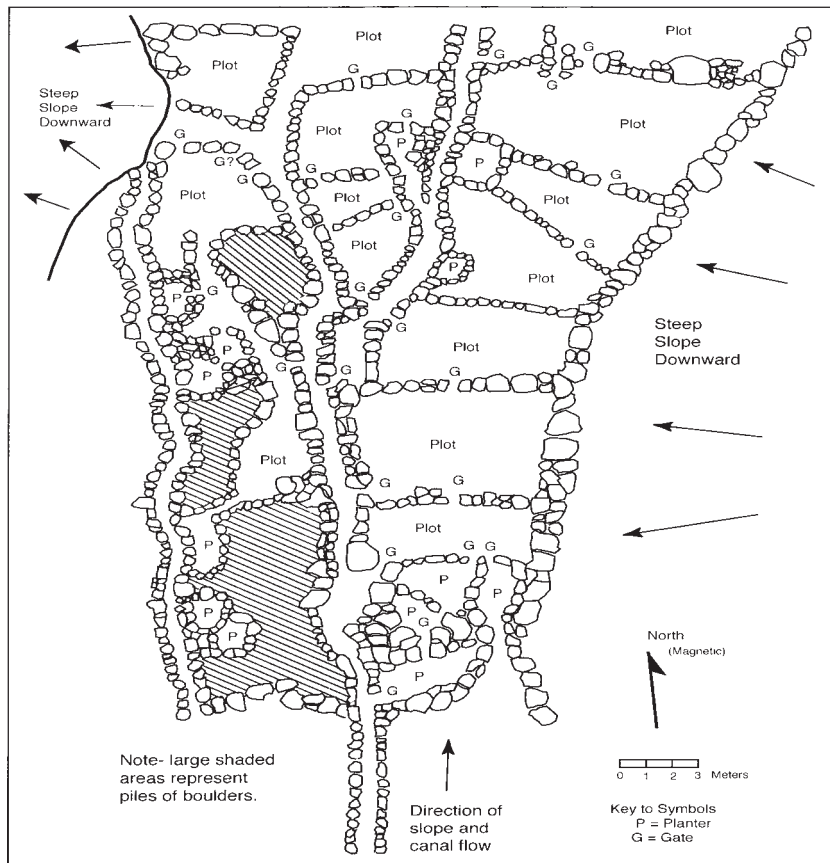
Most or all of these fertilizer enhancements were likely used for hand watering special corn that was used to make tesquino corn beer, as fertilized corn has a high sugar content.

**Pre-Classic Mayan foundations for fertilizer production** - I have found substantial support that some of these ideas were in circulation since the Mayan pre-Classic period of 600BC-AD150 in the Mirador Basin of northern Guatemala. Professor Richard D. Hansen, under the sponsorship of National Geographic and as documented on PBS, states “the Mirador Basin of the pre-Classic Mayan period had an economic agricultural engine where marsh muck from local swamps was deposited into terraces to produce fertile soil for the growing of corn and other crops. These deposits equaled thousands of tons of transported organic soil material. Some of these terraces were more than 3½ meters (10 feet) deep.” Professor Hansen further stated that these agricultural methods are evident throughout the Mayan era into the time of the Aztec Chinampa swamp dredging agricultural system.

This ancient knowledge would be the basis for our Paquimé/Anasazi/Hohokam “natural systems” agricultural methods for producing fertilizer. Marvin Harris, from his book *Cannibals and Kings*, points out a fascinating method in which the Peten Maya C.E. 300-800 had a way of produced fertilizer in a structure that looks something like a Chaco “road.” Although Harris and his colleagues, including C.L. Lundell, never actually realized that the Maya were producing nitrate rich water for fertilizer, their basic analysis for the use of the linear depressed swale where leaves from dry season deciduous trees decayed was, I believe, correct.



The only known pre-Columbian ballcourt in the Southwest was found at Paquimé by Charles DiPeso and featured a drain and a goal ring, C.E. 1250-1425. (above)



## Fertilizer Rosetta Stone Tarahumara Ethnographic Evidence



Male Sky God with “stepfret” lightening legs. Three Rivers Petroglyph. Permission granted Joe Ben Sanders.



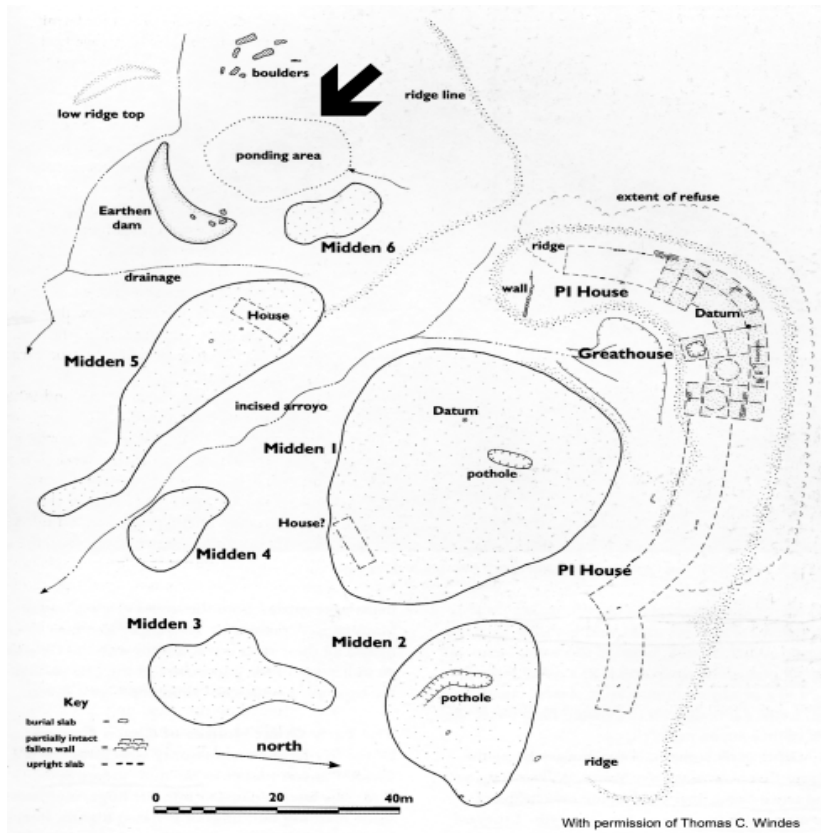
Monumental art-female fertile rain attractor. Practical application is the making of fertilizer from a mix of rain associated with lightning and detritus/waste materials. Wupatki “Ballcourt” Permission granted Adriel Heisey.

In the late 1990s, Professor James A. Neely published on his excavations at Lefhand Canyon a unique new system of gates and pools that was clearly an agricultural enhancement. This site is located on the northern flanks of the Pinaleno Mountains just south of the Gila River near Safford, Arizona. He has investigated a unique irrigation and garden system. He believes that this site dates to C.E. 1275-1315, and that these were migrant Western Anasazi, based on the pottery styles.

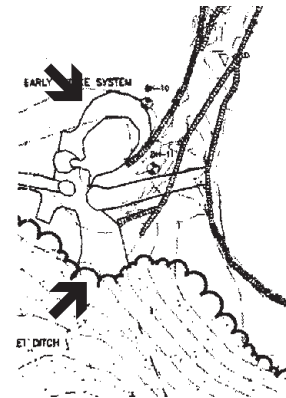
His schematic drawing illustrates small turnouts, or gates, in the canal that controlled amounts of water to be diverted into fields and into stone-bordered “pools.” .... The pools vary in shape and size. In all, about 100 of these pools were recorded in Canal System 1. They were likely designed to impound small amounts of water, where farmers could dip water onto wilting plans, as needed, but their precise function is not known with certainty. He did not know the purpose of the intake gate and pool system.

This was my third specific archaeological find that supports my argument and is now one of six or more specific examples of my proposed use. (Neely & Hom-burg)

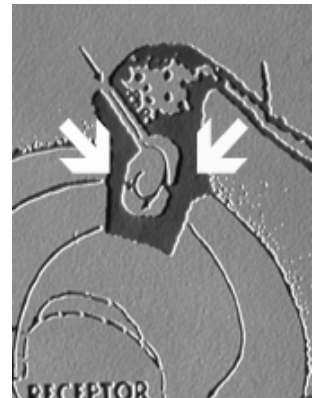
Courtesy Professor James A. Neely



The Casa del Rio site should be evaluated as a possible multiple platform mound and fertilizer production site. --- (Late C.E. 800's - Windes)

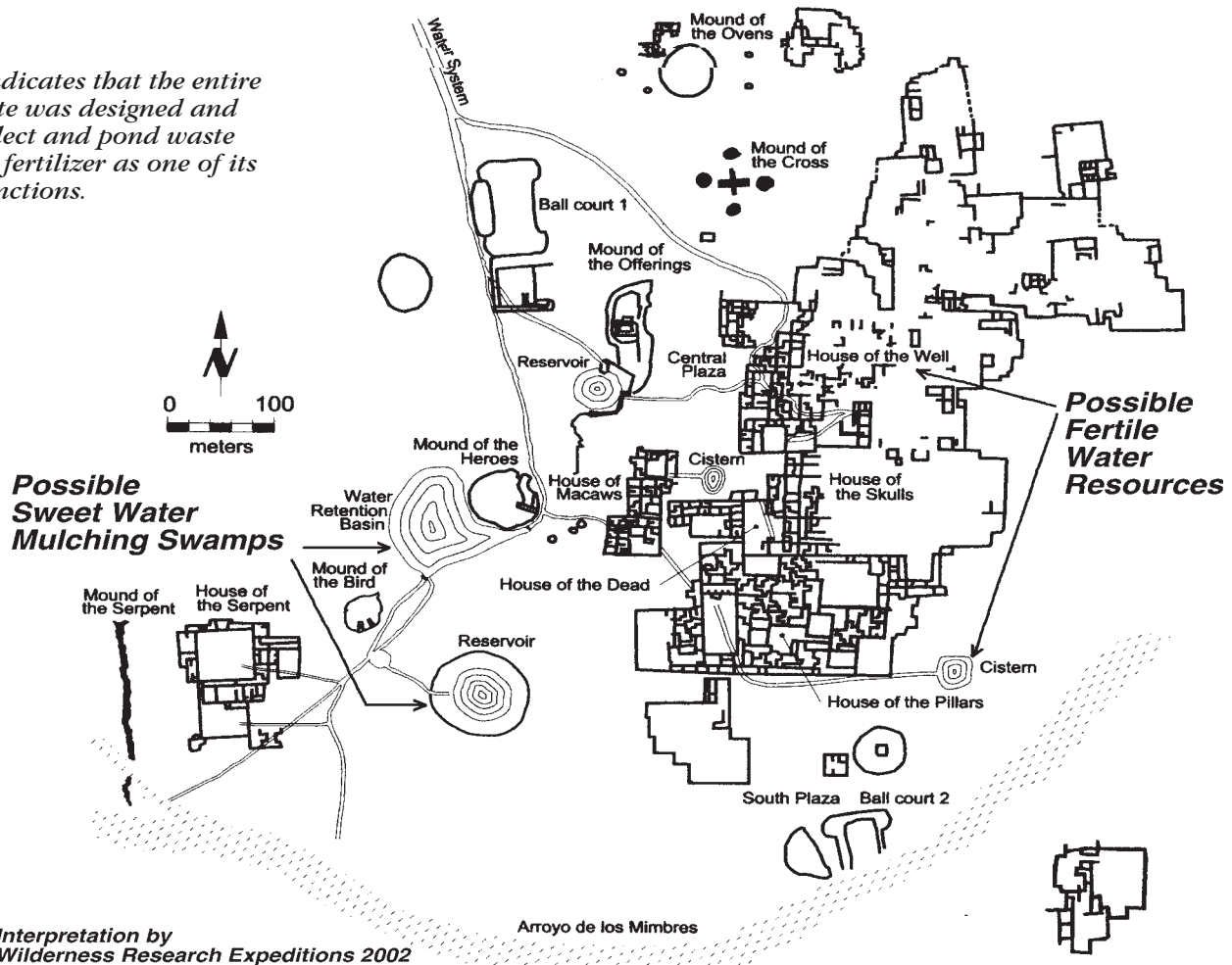


"Early intake system."  
Mummy Lake, Mesa Verde C.E. 1200



Water Mixing intake system. Paquimé C.E. 1400

Evidence indicates that the entire Paquimé site was designed and built to collect and pond waste for making fertilizer as one of its primary functions.



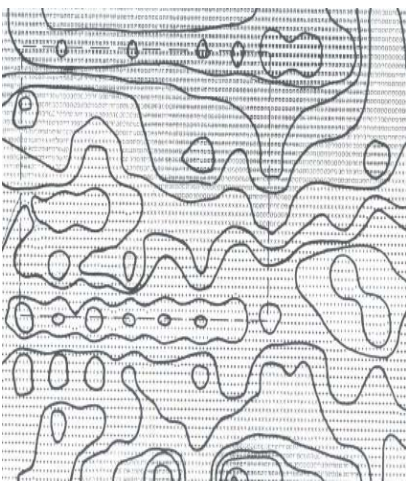
# Natural Fertilizer Harvesting and Production, Anasazi and Hohokam



*Chacoan Swale. Permission granted Adriel Heisey*



*Bluff Great House Road Permission granted Gene Stevenson, geologist, Bluff, Utah.*



*Topographic Analysis, Chetro Ketl field. Permission granted Richard W. Loose*

**Chaco Canyon Roads, Monumental Art or Agricultural Swales?** As the photo on the left indicates, in many cases the constructed structures which have been identified as roads are, in fact, depressed swales. Investigation could determine if they were created to collect runoff from cryptobiotic soil which would naturally fertilize corn and other crops with soluble nitrates. I observe that if the Anasazi and others built structures that actually collect water, that is probably what they were built for. Stratigraphy and Palynology for the road swales has not been done so it is not known if corn was grown in these swales (Kincaid). A good example of a similar swale that may have been originally interpreted as a road and was later found to be a linear water collection basin is at the Mayan site of Peten. A thorough study of this proposal is certainly warranted.

Cyanobacteria, previously called blue-green algae, are one of the oldest known life forms. (Belnap). Summer monsoon storm events produce soluble nitrates when the rainfall passes through cryptobiotic soils and pours over canyon rims into Zuni gardens (Pawluk). Tom Huntsberger reports that during a field study, he did a pre and post thunderstorm nitrate analysis of an area in the Colorado Plateau where cryptobiotic soils are common, and found that subsequent to the rainstorm, the nitrate levels were dramatically higher.

"Cryptobiotic soil crusts, consisting of soil cyanobacteria, lichens and mosses, play an important ecological roles in the arid Southwest. In the cold deserts of the Colorado Plateau region (parts of Utah, Arizona, Colorado, and New Mexico), these crusts are extraordinarily well-developed, often representing over 70 percent of the living ground cover. Cryptobiotic crusts increase the stability of otherwise easily eroded soils, increase water infiltration in regions that receive little precipitation, and increase fertility in soils often limited in essential nutrients such as nitrogen and carbon" (Harper and Marble, 1988; Johansen, 1993; Metting, 1991; Belnap and Gardner, 1993; Belnap, 1994; Williams et al., 1995).

I propose that in most cases "roads" are raised above the surrounding landscape to prevent ponding of water and protect the roadway from erosion during heavy rainstorms. Clearly Chacoan roads do not follow this worldwide norm.

John Rooney, who supervised the phase two Chaco Road project, said he did not think the swales were built for transportation and communication. Rather, he felt it was some type of monumental art. He did indicate, however, that when he lost the "road" he was able to follow the plant litter as it created a dark line of organic material which collected at the bottom of the swale. He indicated that he had never heard of the cryptobiotic soil proposal but he did not see why they would grow crops so far from home. I suggest that nothing within a one hundred mile radius of any modern or ancient pueblo would be considered "far away" by the Tarahumara Indians and I propose the Chacoans as well.

I propose there were three types of "roads." One was actually a bi-way from one location to another, such as the Padilla Well to the Great Kiva (Freedman). Another type was a construction from an old house to a new house, such as Kin Hoghoi-Atsee (Freedman). The third type crossed large open plains of cryptobiotic soil crust as agricultural swells for growing corn.

**Making fertilizer in Chaco Canyon** - Slot Canyons, such as this one above Pueblo Bonito, collect soluble nitrates from rainfall on the surrounding cryptobiotic soils. One can easily observe the obvious female shape of what I propose are natural mixing basins (left).

After thinking about the Chetro Ketl field for thirty years, I am not at all convinced that it was an agricultural garden. The entire field was a series of basins approximately 4x5 meters each, comprising eleven acres in all. The soil is horrible, choked with calcium carbonate and sodium sulphate which created an impermeable water barrier (preventing any root systems from developing). These basins were sculpted or excavated out of the basement strata between the levies. The basins were coated with a clay layer that may have been from a flood event or, John Stein believes, the clay was hauled in and layered, however. Chaco Canyon was singled out as very poor farmland by the US Soil Conservation Service in 1936" (Loose).

I propose from this data that the Chetro Ketl field was not a "grid garden." It was rather an ingenious design of fertilizer dehydration basins. I now question whether any significant agriculture was practiced in Chaco Canyon proper. I believe that the Chacoan elite controlled agriculture throughout much of the San Juan Basin by harnessing the unique topographical characteristics of dehydration basins that allowed for the exploitation of the fertilizer produced by the cryptobiotic soil. The Chacoans harvested and dehydrated the blue-green algae in the uniquely efficient basins in evidence at the Chetro Ketl field. I believe this dried fertilizer could be efficiently transported throughout the 60-100 mile Transhumance radius. While great logs and tons of corn were transported into the central canyon proper, I propose fertilizer was being exported on the return trip.

Combined with my Transhumance proposal, this fertilizer producing method would have given the Chacoans a visible means of support in this otherwise extremely harsh and inhospitable environment. In fact, evidence suggests this is why the Great Houses of Chaco Canyon were founded in this location.

### Distribution in Time and Space of Macaws of Known Age

Chaco Canyon	(CE 850-1150)	29
Wupatki	(CE 1150-1200)	20
Tuzigoot	(CE 1150-1200)	2
Ridge Ruin	(CE 1150-1200)	2
Hiatus	(CE 1200-1275)	0
Grasshopper	(CE 1300)	8
Kinishba	(CE 1300)	4
Paquime	(CE 1250-1425-1475)	504

### Related Mesoamerican Centers

Site	Dates
Tarascan	± AD 1300-1521
Aztec	± AD 1250-1521
Toltec	± AD 900-1250
Chalchihuites	± AD 550-1200
Alta Vista	± AD 450-1000
La Quemada	± AD 650-800
Teotihuacán	± AD 150-750

### Mesoamerica-Anasazi Macaws

Site	Dates	Macaws
Paquimé	± AD 1250-1425	504
Point of Pines	± AD 1250-1400	28
Grasshopper	± AD 1280-1375	13
Turkey Creek	± AD 1275-1300	15
Gila Cliff	± AD 1275-1300	1
Sinagua-Wupatki	± AD 1150-1250	53
Rio Grande	± Post AD 1400	9
Salado	± AD 1225-1400	5
Kiet Siel	± AD 1250-1300	1
Chaco	± AD 850-1130	34
Snaketown	± AD 600's	3

# Where Did The Chaco Canyon Anasazi Come From and Where Did They Go?



“Follow the Scarlet Macaws.” I would agree with the Hopi writer Leigh J. Kuwanwisiwma that Chaco Canyon was founded by the “Parrot Clan.” Evidence indicates that these followers of Mesoamerican religious practices intermarried with local indigenous Puebloan people and founded a unique dynasty in southwestern prehistory.

As the Chaco Canyon Anasazi move evidence indicates that it is possible to follow the believers in the Sun God/Scarlet Macaw belief system progressively south to Wupatki, Point of Pines, Grasshopper and Kinishba ending up at Paquimé.

Charmion McKusick reports that the Scarlet Macaws were sacrificed C.E. 900-1200 and that later the macaw feathers were harvested, but the birds were not sacrificed after C.E. 1275. McKusick further states “While macaws can be handled without injury by their keepers, they are vicious birds which could not be traded hand to hand. It would be necessary for an experienced courier to transport marketable macaws.”

The Scarlet Macaws are the signature element of Mesoamericans in Anasazi culture.

Leading archaeologist, Steve Lekson, states there is a “tendency to minimize rare things. Only a few macaws, therefore, macaws are not important. That logic escapes me. Rare stuff is supposed to be rare. If we found a jade mask at Pueblo Bonito, would we belittle it because there was only one? Macaws are the moral equivalent of jade masks. Highly specialized knowledge needed to transport and maintain macaws makes the 1,000 km (621 mile) trip (one way) to obtain those cantankerous birds a *very* big deal, fully comparable to jade-working. This was no “down-the-line” exchange; the idea of a macaw being passed up and over the Sierra Madres, from hill tribe to hill tribe, is absurd. Instead of minimizing the 30 macaws and two dozen copper bells recovered at Chaco, wishing them away, we should dance jigs of joy that the archaeology gods have given us these astonishing data” (Lekson).

I would strongly agree with Lekson accept that I believe in context, that the Scarlet Macaws are not that rare. While material items such as ceramics and shells may be more common, these assemblages do not carry nearly the value of biological remains of a macaw.

**Round Stones and Grain Growing Cultures** - The theory that round stones were used as foundations is a very risky one for a grain growing culture like the Chaco Canyon Anasazi. It is more likely that these round stones were used for some type of grain processing. The fact that they also appear at Paquimé at a much later date and are not associated with “kivas” indicates that their use needs to be investigated in much more detail. (below)



*Worn Anasazi Round Stone, Aztec*



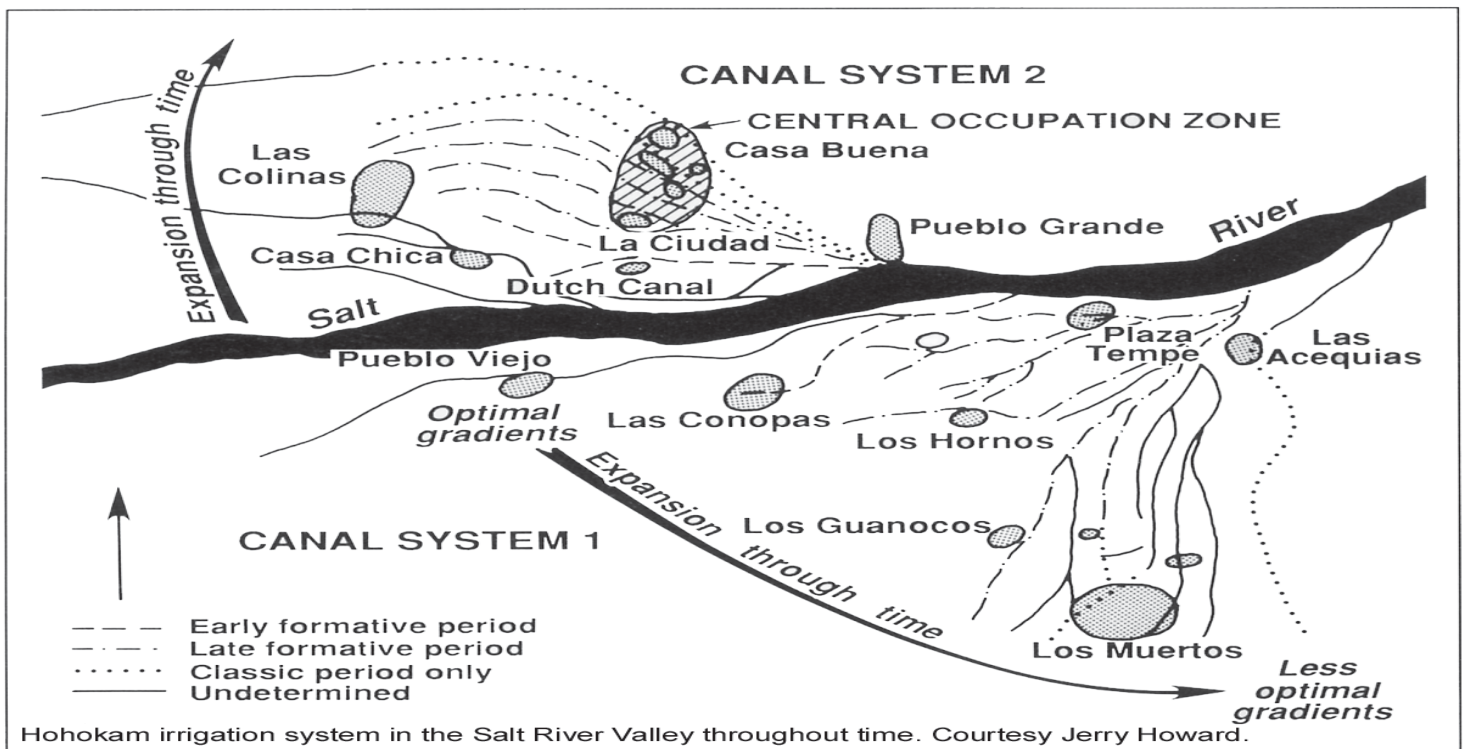
*Anasazi Round Stone, Aztec Great Kiva*



*Chaco New Round Stone*



*Paquimé Round Stone*



*When provided with adequate water, native mesquite produces a prolific supply of food, building material, and firewood. Mesquite is approximately 50% of the food product recovered from Hohokam sites.*

**The Hohokam Canal System and Mesquite** - The Hohokam canal system was probably built primarily for the cultivation of a Mesquite Bosque. It has been long questioned why the Hohokam built such an extensive system on one of the saltiest rivers in North America. Bean and especially corn cultivation is moderately to severely impacted by saline water and salinity. Mesquite is not impacted by levels of salinity found in the Salt River basin. My observation is that the Hohokam's primary reason was to grow mesquite in the "delta" shaped canal system and mesquite conditioned the soil for corn and beans with nitrogen, and shade temperature reduction, and moderated freeze sensitivity in the winter.

*Prosopis L.* Mesquite, as described by Franklin T. Bonnerscientist emeritus USDA Forest Service, is a tree which is "a hardy nitrogen-fixer. Mesquite legumes make high-quality forage for livestock and wildlife, and the seeds were widely used by Native American peoples in the Southwest (Davis and others 1975; Marting and Alexander 1974; Vines 1960). The crude protein contents of honey and velvet mesquite seeds are 31 and 24%, respectively (Becker and Grosjean 1980), and the legumes

of honey mesquite are high in carbohydrates (Harden and Zolfaghari 1988)."

Professor Todd Bostwick said "the Hohokam would have always faced the challenge of soil salinity, yet they farmed the same region for more than a thousand years, indicating that they understood how to deal with soil salinity — through the flushing of soils, leaving certain tracts fallow, alternating crop types planted, and other soil management techniques. Mesquite comprises approximately 50% of the archaeological record as compared to corn and beans."

While I agree with Professor Bostwick, my observation indicates that, from the archaeological record, the canal system was built primarily to "grow mesquite" for food, fire wood, and building materials. Worldwide, especially in very arid climates, trees are grown as an agricultural crop, and the Hohokam were doing the same.

Mesquite is a legume and as such it provides probably the "other" soil management technique used to add fertilizing soluble nitrates the soils.

In interviews, neither professors Bostwick nor Howard, indicated that the Hohokam used "grid gardens" which have been proposed as the primary agricultural design during that time period elsewhere in Oasis America. I suggest that the Salt River mesquite delta across the Phoenix Valley also functioned in such a way as the salty water was used very little for corn and beans or perhaps not used at all. The primary parasite for corn is root cutworm and with very few hours below freezing each year, gardens in the Phoenix Valley could perhaps have only been used for a year or two maximum due to root cutworm infestations. I propose that the strategy used by the Hohokam was to maintain an extensive mesquite forest watered by the canal system and that the gardens for corn and beans were moved throughout the "delta" continuously.

Another factor to consider is that some of the canals are very deeply incised. This would have put the irrigation water well below any usable level for corn and beans, but would have been ideal to water the deep tap roots of the mesquite.

# Chaco Canyon Anasazi End of the Anasazi: Iron Deficient Diet-Anemia

by Richard D. Fisher

## Abstract

Since the 1970's, a debate has raged concerning the abandonment of the Anasazi, Hohokam, and Paquimé regions of the American Southwest and northern Mexico (a region which I call Oasis America, which is characterized by oasis and rivers in a desert environment). Drought, famine, erosion, deforestation, salinity, soil infertility, warfare, cannibalism, and general resource depletion have all been proposed as causes for the desertion. For the most part, these reasons have been found not to be a primary cause of abandonment. I concur, after thoroughly researching each of these issues, that all of these "causes," taken together, very likely contributed to the severe dietary stress of the Anasazi/Hohokam/Paquimé cultures but were not the primary causes.

In a related debate, Marvin Harris proposed that a lack of "red meat" might have been a causation. He argued that a simple diet of corn and beans was not adequate to support complex, high-density cultures. Later, Louis E. Grivetti demonstrated that corn and beans did provide the adequate essential amino acids necessary for basic nutrition in pre-Columbian North America but does not address the general health of the population required for large building projects such as Pueblo Bonito at Chaco Canyon utilizing these very limited dietary resources.

I would argue that a very specific lack of dietary iron was the ultimate root cause of the abandonment. I further propose that this might also be interpreted as the cause of the scientifically validated cannibalism in the Anasazi areas (Turner and others). It is widely accepted by archaeologists and anthropologists that pre-Columbian North Americans, in fact, had very few domestic animals. Harris correctly points out that these domestic animals competed with humans for the basic foods: corn, beans, and wild red meat. The lack of red meat and animal fats, due to the severe depletion of locally available wildlife, was a significant challenge to complex, high-density cultures such as that at Chaco Canyon. I agree, as well, with Grivetti that corn and beans would have provided the essential amino acids but the evidence demonstrates they could not provide the absolutely necessary dietary iron.

I propose that it was the essential lack of dietary iron that presented the Anasazi with a final and insurmountable obstacle to high-density, complex culture without resorting to cannibalism. I further observe that some groups of the Anasazi and others resorted to cannibalism (as did the Aztecs), but this practice was rejected by the majority of the population. It is noted from the following paper that Chaco Canyon has the highest rate of anemia when compared to the other Anasazi sites. Considering the bone evidence for the very poor nutritional status at Chaco Canyon, it is surprising that the Chacoans were able to accomplish any vigorous tasks at all. This contradiction highlights the very poor understanding of Chaco Canyon agriculture and lifestyles currently. My proposals provide the key for pursuing the resolution of this mystery.

**Health and Disease in the Prehistoric Southwest a sum-**

**mary of key writings on Anemia** - "Mesa Verde has yielded an abundant amount of skeletal remains (500 or so) from numerous excavated sites dating from 600 B.C. to A.D. 1300. Most of the remains are from the later time periods (A.D. 1000-1300) ... a low life expectancy as indications of a stressed population.

According to Akins, Chaco Canyon Anasazi suffered from what she terms "subsistence stress" as indicated by growth disruption, high rates of nutritional anemia, and degenerative diseases (1986:135). ... "authority-holding elites had greater access to nutritional resources and enjoyed better health (1986:137-140).

Bone density in adult males and females is the lowest during the abandonment phase, which probably reflects poor overall nutritional quality at that time. ... In addition to studies on the Mesa Verde and Chaco burials, human skeletal remains from the

Kayenta region have also been analyzed. ... Similar to previous studies, Wade suggests that health was poor, with a slight trend toward increased stress in the later time period.

Ryan (1977) used Wade's Puerco Valley sample but combined it with burials from several other Kayenta Anasazi sites (A.D. 750-1300) and one historic Hopi site (Old Walpi, A.D. 1300-1700). His sample consisted of 353 burials representing Pueblo II through Pueblo IV occupation. ... Ryan suggests that health status dramatically decreased during the final stages of occupation. ... the study by Palkovich (1980) of 120 burials from Arroyo Hondo, located

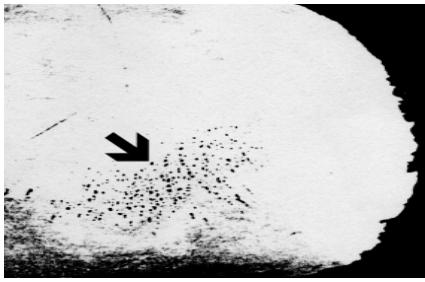
in central New Mexico in the Rio Grande area. This enormous site was occupied during two separate periods referred to as Component I (A.D. 1300-1330) and Component II (A.D. 1370-1420). Each occupation shows growth, prosperity, and sudden decline. ... Palkovich paints a harsh picture of the Arroyo Hondo Anasazi. Most individuals were afflicted with some pathology, and infant mortality was very high. Of the 54 subadults aged to 10 years, she further documents a very high rate of active infections and anemia in infants under the age of one (Palkovich 1987). ... Palkovich speculates that Arroyo Hondo infants have immediately acquired infections from their mothers, implying that maternal health was greatly compromised during pregnancy.

the study of Arroyo Hondo ethnobotanical reconstruction of food and diet, suggests strongly the presence of endemic malnutrition. ...

One common finding almost all the paleopathological studies reviewed here is the presence of nutritional anemia. El-Najjar and colleagues (1976) compared numerous Southwest skeletal populations based on dependency on maize (which is assumed to be a poor source of iron, protein, and other nutrients). Their sample was drawn primarily from Chaco and Kayenta sites, and they divide them into two ecological types: canyon bottom sites (maize-dependent subsistence) and sage plains sites (mixed maize subsistence). The study documents much higher frequencies of nutritional anemia in the canyon bottom sites and concludes that maize dependence in marginal areas such as those found in the Southwest predisposes individuals, particularly children, to health problems. ... Walker expanded this



*Porotic hyperostosis in the orbital region.*



*Porotic hyperostosis of an infant parietal that is slight in expression.*

cultural variables relating to nutrition and infectious disease. Lack of iron in the diet, prolonged breast feeding, diarrheal and helminth infections, and living conditions conducive to the spread of disease all appear to have contributed to the prevalence of [anemia] [1985-153]."

characterize health in the following manner: major nutritional deficiencies resulted from a corn diet ... major concern; most adults had arthritis and spinal degeneration from carrying heavy loads; parasites such as lice and helminths were common; and infant and childhood mortality was high.

Of these indicators of nutritional stress, porotic hyperostosis (resulting from anemia) is among the best-studied indicators for archaeological populations. Anemias can potentially affect any bone of the skeleton that is involved in the production of red blood cells. The extent of the involvement of postcranial as well as cranial bones usually indicates how severe an anemia is and whether it is associated with genetic abnormalities of hemoglobin or with nutritionally induced anemia (Stuart-Macadam 1987). ... nutritional anemia has been suggested to be the primary factor in the etiology of porotic hyperostosis for the vast majority of the documented cases in prehistory (Carlson et al. 1974; El-Najjar et al. 1975; Hengen 1971; Mensforth et al. 1978; Palkovich 1987; Stuart-Macadam 1987; Walker 1985).

Porotic hyperostosis is a descriptive term for lesions on the cranium, the roof of the eye orbits, and the ends of long bones. These lesions are produced by bone marrow proliferation that is diagnostic of anemia. The lesion, as the name implies, has a very porous (coral-like) appearance that develops when diploe (the trabecular portion of the cranial bone that separates the inner and outer surfaces) expands.



*Porotic hyperostosis of an infant parietal that is severe in expression*

Population-Level Analysis of Porotic Hyperostosis

A total of 119 individuals (approximately 69%) of the Black Mesa skeletal collection could be analyzed for the presence of porotic hyperostosis of the cranial vault, and 92 individuals (approximately 53%) of the collection could be scored for porotic hyperostosis on the orbits....

Iron-deficiency anemia is present on 87.7% of the Black Mesa individuals (showing either or both cranial and orbital expressions, either active or healed).

... early (A.D. 800-1030) and late (A.D. 1070-1150) Pueblo periods on Black Mesa ... For frequencies by severity, the only major difference is that there are no severe cases in the early period and five cases (20.0%) in the late period.

...data suggests that at least half of the Black Mesa adults were experiencing iron-deficiency anemia at the time of death, and

finding with an exhaustive review and synthesis of the published literature on anemia from all major Southwestern sites. ...

"The remarkable prevalence of osseous lesions indicative of anemia among prehistoric Southwest Indians apparently resulted from the interaction of a complex set of biological and

that the rates are comparable with rates of anemia for several other Southwest sites. ...

Iron deficiency anemia was clearly a health problem for prehistoric Anasazi children

Adult males and females are both at risk for anemia which suggests an underlying dietary deficiency because reproductive-aged females are prone to anemia owing to blood loss associated with menstruation and pregnancy. The equivalent frequencies imply a shared diet was low in iron.

"There is a strong case for persistent iron-deficiency anemia on Black Mesa throughout the entire Pueblo occupation. Eighty-seven percent of the population had some form (either active or remodeled) of the disease, and there appears to be slight increases in frequency over time. On Black Mesa, no subgroup appears to be particularly buffered from anemia, although it is clear that infants and the youngest children are the most profoundly affected "(Martin, Goodman, Armelagos, Magennis, p 162)

"El Najjar and Robertson (1976) document a severe case of porotic hyperostosis for a mummy child from Canyon de Chelly, and they point out that the Anasazi diet of maize is an important feature in the interpretation of the disease. An analysis of the maize species (which is a nonhybrid) used throughout the Southwest shows that it is very low in usable iron. ... The nutritive value of the Mexican tortilla has been described extensively (Cravioto et al. 1945) and shows quite clearly that iron content is very low (less than 3.2 mg/tortilla). ...

In an extensive study of the diet of a typical modern Latin American peasant farming village, (Acosta et al. 1984) the data show conclusively that iron content varies considerably according to what proportion of the diet is from red meat (which enhances absorption of iron) and vegetables and maize bread (which inhibit iron absorption). ...

Worthington-Roberts and coworkers (1988) conducted a similar study in the United States looking at the relative importance of red meat in the diet. Iron status was measured for individuals



*Porotic hyperostosis that is active and unremodeled.*

who regularly ate a variety of meat products and individuals who were vegetarians. Iron status of the vegetarians was quite poor, with many of the individuals of that group having evidence of iron-deficiency anemia. Thus, the importance of meat in the diet in sufficient amounts seems critical for meeting dietary requirements of iron" (Martin, Goodman, Armelagos, Magennis).

The Taloc, which is a fearsome goggle-eyed toothy petroglyph, I propose, was the symbol for the disease of severe anemia. This disease which was well known to the Anasazi and perhaps manifest itself in hollow-eyed faces which also featured diseased and receding gums in some cases.

**Conclusion** - Collected evidence suggests that when the large mammals were eliminated within a three days run (the time it takes meat to rot), the "elite" in the major centers had an unresolvable problem obtaining dietary iron from animal sources. I do not think that the builders of Chaco Canyon were surviving on "rabbit drives." My research indicates that anemia was the driving force for cannibalism and that cannibalism was not acceptable to the matrilineal indigenous clans of the Anasazi. This was the fundamental driving factor that caused the Anasazi to abandon the San Juan Basin.

## Reported Anemia Percentages at Selected Anasazi Sites

Site	Timeline	Children	Adults
Black Mesa	(A.D. 800-1150)	85.40%	89.30%
Canyon de Chelly	(A.D. 700-1300)	88.00%	45.90%
Kayenta area	(A.D. 1000-1150)	42.90%	9.50%
Chaco Canyon	(A.D. 900-1150)	88.30%	65.00%
Navajo Reservoir	(A.D. 700-1100)	15.90%	10.40%
Kayenta-Puerco	(A.D. 1150-1250)	46.70%	10.00%
Inscription House	(A.D. 1250-1300)	63.60%	46.20%
Arroyo Hondo	(A.D. 1300-1350)	20.80%	0%

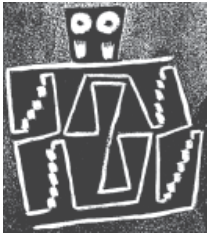


**Chaco Canyon accentuated “stepfret” design** - At Chaco Canyon the “stepfret” ceramic design is very dramatic and sharply pointed. I believe the black and white relief symbolizes a dualistic universe, male and female. I also suggest that the very sharply angular stepfret design used at Chaco is indicative of male lightning which they associated with fertile rainfall. At Chaco the stepfret was primarily lightning male and at other Anasazi locations represented the more female 90 degree angle step.

## Selected Anemia & Scarlet Macaw Archaeological Sites



# The Anasazi and Cannibalism?



*I propose this is the taloc face of anemia and perhaps cannibalism.*

Mesoamerica, dating back 2,500 years, and Turner believes the cultists used it to terrorize and control the Anasazi. Remains at the Puerco River site are very similar to remains of victims of ritual sacrifice in Mexico, Turner says. 'We choose to see it as a group of people coming in and taking over in a very gang-like behavior,' he said. '(Cannibalism) was their gimmick. This was their weapon'" (Gehrke).

"Food for thought. *Man Corn*—named after the Aztec word for a sacred meal of human meat—provoked a fire storm. Critics have charged him (Turner) with everything from shoddy science to racism. He countered with a widely distributed manuscript—rejected by *American Antiquity*—denouncing them as "professionally reckless," "politically correct," and "rude."

Turner's proposal that ancient Mexicans invaded from the south has aroused the most derision. "The idea of a [Mexican] goon squad is ridiculous," says Kurt Dongoske, an archaeologist for the Hopi tribe. While remnants of trade with Mexico exist—pottery, copper bells, and macaw skeletons—there's little evidence of Mexicans' living in the area at the time. Turner's theory hangs on one skull found with notched teeth, a practice common in Mexico but rare in the Southwest. "Turner stepped beyond his level of expertise," sniffs Steven LeBlanc, director of collections at Harvard's Peabody Museum of Archaeology and Ethnology.

Turner has his allies. Tim White, professor of human evolutionary studies at the University of California-Berkeley, compared broken, scarred, and scattered Anasazi and animal bones from Mancos Canyon in Colorado and discovered striking similarities. He dismisses the reburial theory, saying no other society uses the same method to prepare food and bury its dead. Even so, he refuses to speculate about who was behind the cannibalism. 'It's too early,' he says" (Hartigan).

"Regardless of whether one accepts Christie Turner's theories of rampant cannibalism, he makes a convincing case that whatever led to these bone assemblages, it was violent and mutilative. Gastronomic customs aside, something terrible happened to these people and cannibalism is only one tentative detail in something far more complex. While people rush off to rewrite cannibalism into the history of the Anasazi or Ancestral Pueblo, it is important to note that it is as of yet uncertain who were the victims and their attackers" (Burn).

The tribes north of Durango and Sinaloa, Mexico eliminated cannibalism before the arrival of the Spanish (Lascano).

"I believe there were times in the Southwest when cannibalism was necessary. As a child, I heard stories of historic Pueblo people's resorting to eating other people during times of extreme stress" (Swentzell).

"There were also people who had traditions of human sacrifice, who were also not admitted (into the Hopi)" (Emory Sekaquaptewa).

**Chaco time period decline in the level of warfare. Significant increase in warfare after C.E. 1200 (LeBlanc)** - I argue that the Chaco Canyon Anasazi developed strategies for produc-

ing large surpluses of corn which led to an extended period of relative peace, but eventually led to increased population, depletion of available dietary iron (local wildlife populations) and eventually increased warfare. The Chaco Canyon people likely intermarried with the peoples of the Great Sage Plain (Cortez-Dove Creek) in southeastern Colorado (Breternitz). As violence increased, people began to move permanently into the large centers such as Yellow Jacket, Lowry, Sand Canyon, and Escalante. As the Great Drought of C.E. 1276-1299 pushed the environment to the limit, the granaries were emptied of corn and people moved into these structures until the abandonment in approximately C.E. 1280 (Kunkleman).

Chaco Canyon colonizers came into the established Great Sage Plain communities, intermarried and built their special style of great houses such as Lowry, Ida Jean, Goodman Point, Escalante, Sand Canyon, and Wallace. There were two distinct periods of colonization in the C.E. 1090's and the C.E. 1120's. Most, if not all, of the great houses were abandoned at about C.E. 1150 which marks the end of the Chaco era throughout the region. The entire region was abandoned by C.E. 1300 (Breternitz).

I propose that the Chaco Canyon Anasazi brought with them their design of great corn silos. It is my proposal that centralized storage facilities (grain silos) was one of the unique Chaco Canyon architectural innovations. The Great Sage Plain Anasazi adapted these as they proved to be an ideal way for long term storage of corn as well as a great social center where corn beer was perhaps one of the important motivators for the life style during this time period C.E. 1090-1275.

**Abandonment and Reuse** - "Twenty-five to thirty percent of the Anasazi could have survived with the resources available during the great drought" (C.E. 1276-1299)(Gummerman). I observe that archaeologists are not currently looking at the specific impacts of severe anemia, but rather are addressing a general decline in food resources throughout the region during the great drought.

It has been demonstrated that the Anasazi survived numerous droughts, and I believe their long term storage capacity in the system of silo/kivas may also have cushioned them in such a way as they could have survived the great drought as well. They certainly could have returned after the great drought, which they did not. I propose that it was a near extinction of large game animals throughout the region and the rarity of smaller game that made it virtually impossible for the Anasazi to reestablish their culture in the San Juan Basin. The large game animals may take hundreds of years to repopulate their former ranges preventing the Anasazi from returning after the drought. I further point out that there were previous abandonments in the San Juan Basin and that brief periods of re-population were possible for a short period of time. Chaco Canyon was abandoned in approximately C.E. 1150 and re-inhabited for a short period in C.E. 1250 by Aztec and Mesa Verde peoples (Bodnar).