Early Villages in the Western Hemisphere

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INTRODUCTION

With the onset of the Holocene, sedentary village life appeared in widely scattered locations around the earth. Farming, facilitated by domesticated animals, which could provide fertilizer and food, produced a diet that when supplemented by hunting, gathering, and fishing describes one path from a nomadic life to a settled one. Fishing is another possibly more ancient path. There are well-known examples of both economies in the Neolithic of Asia and in the Middle East. The earliest villages from the Archaic (Preceramic) stage of the Western Hemisphere are those of fishermen.

EARLIEST VILLAGES

One can define the archaeological signature of a village as one left by multiple, clustered domestic structures of between approximately 80 and 1,500 inhabitants. Larger settlements are more conveniently referred to as towns, smaller ones as hamlets. Early dispersed settlements would be difficult to distinguish from hamlets without very widespread excavation.

The end of the last glacial period saw the first agglutinated villages in the archaeological record, and they were in the Eastern Hemisphere. Farming villages emerged at Xinglongwa sites such as Jiahu in inland China, 9,000 years ago, and possibly earlier. These sites are characterized by having large domestic structures and ceramics. In the Middle East, Pre-Pottery inland Neolithic sites, such as Biedla in Jordan, were

occupied by 9,000 BP. Jomon fishing ceramic-using villages in Japan have been reported with accepted dates of 10,000 BP, although they may be older.

In the Western Hemisphere, the Peruvian preceramic site of Paloma was a small settlement at 7,800 BP, growing to a peak of several hundred by 5,000 BP. Valdivian sites from Ecuador, such as Real Alto, began to appear in the archaeological record shortly before this time; they had pottery and a variety of cultigens. James Zeidler and Deborah Pearsall have shown that Valdivian peoples moved up the middle valleys from the earliest settlements in coastal Ecuador, suggesting initial and perhaps continuing association with fishing.

Conditions for Sedentism in Early Villages

It might seem surprising to find that early fishermen lived sedentary lives. However, we know that Jomon fishermen lived year-round in their villages because shells in their sites showed daily and seasonal growth increments. Early settled village life can appear variously with or without intensive cultivation of plants, domestication of animals, or the pottery, needed to store and process produce.

In South America, local conditions near the coast could be optimal for agriculture, fishing, or both. In Peru, the fragile desert habitat is especially sensitive to climatic shifts, and Peruvian villages seemingly began to relocate from below fog oases to river valleys around 5,000 years ago, in response to cooler, dryer weather.

Environmental Factors of Early Sedentism

Improvements in food production would have been stimulated by increasing carbon dioxide from the carbon released by melting glaciers in the early Holocene. The establishment of modern patterns of ocean currents sometime after 5,000 BP would have produced stable beaches where settlers could extract substantial maritime resources. Flood plains and hills above the beaches could also be fruitful for collecting, hunting, and cultivation of plants. By 5,000 BP, the long period of warm, humid environment, that of the Holocene Global Climatic Optimum (GCO), was ending. The result was an increased unpredictability of a new cooler and dryer climate. People had to adjust formerly sustainable systems of subsistence to the new conditions. These cultural changes were important one and can be compared with adjustments to later climatic shifts as discussed, for example, by DeMonocal.

The only laboratories for studying initial adjustments are the first villages. In the Western Hemisphere, it is South American where the earliest villages appear. Villages in Mesoamerica, as for example those reviewed by Kent Flannery, have been well studied, but they appear much later than the ones from South America. Associations between the two areas remain controversial. The origin myth of each begins with the same story, which suggests possible very early contact. Therefore, I will focus on the more likely pristine early villages from South America where the earliest hamlets are known.

EARLY SOUTH AMERICAN SETTLEMENTS

Pleistocene sites such as Monte Verde, Chile, reported by Tom Dillahay, may have had relatively substantial wooden dwellings; Dillahay has also reported habitations from

almost that antiquity in Paijan sites in the north coast of Perú. In central coastal Perú, Frederic Engel excavated well preserved but isolated structures close to beaches at Paracas and Quipa that had radiocarbon dates of between 9,000 and 10,500 BP. Other early fishing camps on the northern and southern Peruvian coasts have this antiquity but lack visible domestic structures. Chilean archaeologists document early fishing settlements up and down their long coast. In Ecuador, Karen Stothert's excavations at OGSE-80 in the Santa Elena Peninsula possibly suggest early agglutinated households by 8,000 BP. However, these sites more likely represent hamlets than villages. As Piperno and Pearsall note, sites from this time period were probably not occupied year-round. Two sites, Real Alto in Ecuador and Paloma in Perú, do meet the criteria of permanent villages.

Real Alto, Ecuador, a Valdivian ceramic-using culture, was studied first by Donald Lathrop and later by Jorge Marcos and Jonathan Damp. Real Alto was more agricultural whereas Paloma relied much more on fishing, so the two represent two different kinds of early villages.

PALOMA, CHILCA VALLEY, PERU

The Middle Preceramic site of Paloma, Perú, is the most intensively studied sedentary village from the middle Holocene of the Americas. The Paloma site is situated 3.5 km from the modern beach on an alluvial fan at an elevation of 200 m above mean sea level, just below a fog oasis. It lies 54 km south of Lima, Perú, eight km from the Chilca River (**Figures 1 and 2**). Frederic Engel conducted the first excavations, a test in 1964 and a cross through the largest low shell mound in 1975. I directed subsequent excavations in

four more seasons between 1976 and 1990 in cooperation with Frederic Engel, Alice N. Benfer, and Glendon F. Weir as co-directors.

Paloma presents three important archaeological resources: (1) its preservation of organic materials is good to excellent, (2) its well-stratified deposits show clearly separable village occupations over time, and (3) it was extensively excavated and analyzed. A list of 25 theses and partial list of publications is available at the PalomaWorld web site at http://coas.missouri.edu/paloma/ (hereafter, PalomaWorld).

There were excavations of parts of 50 structures, 400 storage pits, 35 hearths, and 201 human interments. A series of 26 radiocarbon dates registers earliest occupation at 7,800 BP, with a series of subsequent stratified villages occupied until about 4,700 BP. The final occupation at Paloma was one in which the population began to relocate to a nearby river valley at the site of Chilca 1; the Paloma site was subsequently abandoned for about 700 years.

Paloma is the largest site known from this time period. The site was occupied during the time of the GCO. John Rick has established from studies of the density of radiocarbon dates that this was a time of population increase. The Paloma site is comprised of oval pit houses, three mortuary structures, and shell middens. Many structures were in the low shell mounds; the discarded shells a consequence of the habitation and processing units. A probability sample taken from across the extent of the alluvial fan found others at some remove from a shell mound. A few early domestic structures at Paloma are small and perhaps not evidence of year-round village sedentism. However, large, sturdy houses in clusters were widespread by 6,500 BP. **Figure 4** shows what a domestic structure (S. 128) looked like during excavation; in it some burial pits

and storage pits have been excavated but one storage pit is awaiting excavation. Excavation in this structure, but not most, continued below the floor to the cut originally made by its builders to create an oval depression for the house. The depression was leveled with sand. This and other structures were found in strata delimitable across the alluvial fan on which the site is situated.

Design of the Excavation

The design combined of two major strategies, a small probability sample of test pits and extensive lateral excavations. The probability sample was stratified by depth of deposits determined from shovel tests across the alluvial fan (**Fig. 3**). We were surprised to find that domestic structures were buried throughout the alluvial fan, whether there were surface indications or not, and pleased to learn that structures encountered in the probability sample were not distributed differently from those found in lateral excavations.

We expanded Engel's 1975 original cross through the largest visible shell mound (**Figure 3**). The total excavations were of approximately 2,500 m^2, which corresponds to approximately 10% of the alluvial fan on which the site is situated. Virtually all deposits were passed through ¼" hardware screens; ecological samples were taken from every feature and from selected general deposits and passed through 1 mm or 0.5 mm screens. Raw matrix was obtained from the same contexts.

Stratigraphy

The final stratigraphy of three major levels was established after the major field seasons by John W. Greer, Bernardino Ojeda, and me in 1983. In brief, site wide strata were recognizable by caliche caps and matrix content, texture, and color.

We were able to establish three well-defined strata located throughout the alluvial fan below the fog oasis. Two domestic structures from earlier strata had to be grouped into a single level #400 for the purpose of analysis since they were from strata that were not widely distributed across the site.

Dating

Of twenty-six radiocarbon determinations, only one did not correspond to the level assigned by the 1983 stratigraphy; another sample from the same structure did. The three site-wide recognizable zones are dated as follows:

- #100 Later reoccupation around 4,000 B.P. It had subterranean stone and open areas with scattered living areas indicated by crescents of midden to the north and east of the Paloma alluvial fan, and this occupation is not discussed further here.
- #200 4700-5100 B.P. A level whose presence was announced by a layer of rotted, often purple, shells.
- #300 5100-5300 B.P. A level topped by thick caliche (calcium carbonate) in areas and always containing more grass than either level above or below; the soil was most often orange in color.
- #400 5300-7800 B.P A level of darker soil containing large hearths.

The later strata suggest occupations of a few centuries, probably as persistent villages. The earliest date (7800 BP) applies to only a few small structures from the non-site wide strata, and the major occupation of #400 was from 6,500 to 5,300 BP.

SETTLEMENT PATTERN

The settlement pattern makes clear why good stratigraphy was obtained in what is normally a difficult context, that of a stratified series of villages. The reason is that, once abandoned, structures were never disturbed.

Figure 5 shows the central core of the structures from our virtual reality representation of Paloma, which can be visited at a web site, http://coas.missouri.edu/paloma/, and hereafter, PalomaWorld. These more complete structures from the lateral excavations permit one to appreciate a settlement pattern of agglutinated structures that never intrude upon earlier ones. It is astonishing to report that we did not at first notice the horizontal nature of the stratigraphy in the field, perhaps because we were excavating multiple dwellings from different strata simultaneously.

Vradenburg and his associates found an interesting shift in total house floor area over time. Using a figure of 9.4 square meters of roofed area per person and a 50-year maximum life for a house suggested an average population of about 30 at any one time in level #400 if the earliest date is used. The population would have been twice that size between 6,500 and 5,3,00 BP, the time of the site-wide occupation of level #400. Using the same procedures, we calculated a population of about 450 in level #300, the level whose abundant grass speaks to maximum moisture available for lomas resource. We estimate the lower bound for #200, of about 200 inhabitants who, over time, moved to the

nearby river valley. Not surprisingly, paleodemographic study of the human remains showed a decrease in growth rate in the final occupation at Paloma while the actual local population of fog oasis and river valley was expanding. Other evidence of sedentism includes the more than 400 storage pits, many containing plant or animal food. For example, one grass-lined pit was full of anchovies with heads removed; others contained ground anchovies, and many contained stored plant materials, all suggesting a sedentary life dependent upon stored foods (see **Fig. 4**). A detailed analysis of 75 pits can be found at PalomaWorld.

ARCHITECTURE AT PALOMA

We found three special mortuary structures, but living structures were the most common structures at Paloma.

Domestic architecture

All structures were semi-subterranean in profile; however, the original excavated area was flattened by filling it with sand and then laying down small, fine mats twined from wild plant fibers. Most structures were round to oval with some tending to rectangular. Roof supports were sometimes of willow poles but more often made of groups of cane bound together and set into trenches cut into the inner and outer walls. Roofs were covered with fine mats over which grass was interlaced. Although it virtually never rains at this elevation, a fine mist from the winter fog, “garua,” can wet all exposed surfaces in the winter. The roofs of structures would have condensed water from the fog in this rainless land; excavated house poles were often encased in caliche at their base.

Stone-lined wells of unknown antiquity are found in the nearby fog oasis. Abandoned houses formed depressions, sometimes visible on the surface; condensing water turned the collapsed roofs to caliche. The depressions were subsequently used for discard of garbage. Large basaltic passive grinding stones, batanes, were sometimes cached on or under the roof of houses that had been abandoned. Human burials were found under the floors or sometimes on the floors of dwellings.

Mortuary structures

Of the special mortuary structures found, one, S. 137, is associated with #200 but lies south of the core #200 group and is not depicted in **Figures 5 or 6** (see the true virtual reality "Interactive Site Dig" for details at PalomaWorld). S. 137 resembled a domestic structure in construction technique except that it was only about 60 cm in height. Inside were four burials, the only four not buried in a fetal position at Paloma. One had been disarticulated before reburial, the only instance that we found of this practice. The other three appear to have been buried in a state of rigor mortis. One explanation for all four individuals dying together would be poison from a red tide. Their bodies might have been recovered some time after death. S. 28, contained seven infant burials but no adults, which, if not due to very bad luck in raising babies, suggest it may have had a special mortuary function. Another burial, one extremely well preserved (Tomb 159), was that of a juvenile male missing one leg and exhibiting deep grooves in the corresponding fore arm and hip. He had died from wounds probably inflicted by a shark. He was buried in an isolated location in a small, personal-sized, structure made in the same fashion as the full-

sized domestic structures. However, most of the dead were kept close to the living in households.

A Paloma Household

S. 101 was found just west of a low shell mound (Figure 6). It and adjacent S. 129 (**Figure 7a**) are the two best-preserved structures at the site. They were both from level #200. Over 14 person-months were devoted to the excavation of S. 101; extensive field notes are available at PalomaWorld (where it is listed as H. 101). S. 101 and S. 129 together comprise a domestic household. One is a larger living unit (S. 101), and the other smaller structure, whose presence marked the edge of a shell mound, is the kitchen (S. 129). S. 101 is shown in plan and profile view in **Figures 7b** and **7c**. A reconstruction (**Figure 7d**) by Bernardino Ojeda is in the Museo de la Nación, Lima, Perú. **Figure 7e** shows a modern living unit/kitchen pair from the Andes. That reconstruction lacks the covering grass, as do our representations here and elsewhere, to show architectural details. S. 101 was somewhat unusual in that it was the only structure that we could be sure had a flat roof. The roof itself was preserved by the burning of the structure. We were able to trace ash over a caliche lens from S. 101 to the nearby structure, S. 129. The two returned the same radiocarbon date, 5,010 +/- 60 and 5,010 +/- 80 BP, confirming the field judgment of stratigraphy and an earlier date. Other kitchens may have been missed by our terminating excavation prematurely at the edge of a domestic structure.

Most houses had a patio area demarked by posts, and S. 101 is no exception. It is possible that outer oval of posts might have functioned as the outer wall of the dwelling with the inner more circular row of posts being for support. However, study of partially

burned but largely intact poles, mats, and grass from S. 101 suggest that the area was really a patio for the house. At Paloma, there were hearths both within the central oval of posts and outside them but within the outer ring. Larger communal hearth areas are sometimes found among clusters of houses. We encountered more than 35 hearths of both kinds. Storage pits averaged about eight per household, and many had preserved grass linings and well-preserved storage contents.

Some domestic structures had been reoccupied after a pause, as indicated by several living floors being distinguishable; S. 101 had three floors, each with indications of partial coverage by fine mats. This pattern argues that the dwelling was being used for multiple years, perhaps abandoned temporarily in an ENSO year, then reoccupied. Our finding of five cached batanes in a domestic structure could indicate an abandonment that was meant to be temporary but in fact, became permanent for an extended family. There was an average of four burials interred in and around each of the 55 domestic structures. Few completely excavated houses lacked burials. Paleodemographic study showed that, due to high infant mortality, approximately one-half of an extended family of eight might die in a generation. This finding suggests a lower estimate of 25 years of use for a domestic structure, rather than 50 years employed in the population estimate discussed above.

The kitchen structure S. 129 held a burial of a woman of more than 50 years when she died. Since it and S. 101 were burned at the same time, with S. 101 having its presumed owner interred, one can only speculate that his wife might have died at the same time. She was suffering from a chronic infection that showed up as periosteal lesions on her lower limb bones. The cause of death of either individual is unknown.

Fragments of another individual, possibly a male, were encountered in S.129. We did not find fragmentary human remains at Paloma elsewhere. It is possible that the skull was removed by a fox; a mummified fox was excavated.

There were extensive food remains in S. 129, which is why we identified it as a kitchen. The organic remains were much more dense than in any other structure we excavated. S. 129 was interesting in that house posts were found only in the northern extension shown in **Figure 7a**. Between that small circle and the longer open oval-shaped, main cooking area, we found a platform that was hard, presumably from continued stepping back and forth between the two areas. This and other household compounds suggest that a more intensive processing of food required a separate kitchen structure in the #200 village. The treatment of the dead also changed in #200. There appeared a new pattern, one that suggests the beginning of what would become a continent-wide emphasis on ancestor veneration.

Ancestor Veneration

Tomb 100 (at the bottom of **Figure 7b**) had small hearths just outside the limits of the burial pit. Remains of fire inside burial pits were more common. Fires had frequently been set but not allowed to go out completely before the body was placed in the grave, resulting in the burning of mats, skin, and even scorching of bone. The custom is ancient. Claude Cauchet reported a burial from the north coast dated to 10,200 BP that had been placed on a layer of embers with another layer of charcoal and ashes covering the body. At Paloma, we found embers and burned areas under sides of burials but not ashes covering the body. The custom continued. In Late Preceramic La Galgada, Terrence

Grieder and his colleagues have reported burials interred over a layer of charcoal.

Another use of fire, one that I call ancestor veneration, was the custom in which a dead adult male was interred in the center of the house but not fully in a pit. Such a male was placed on the floor mat or in a shallow depression, and the house was then burned over him. In the case of the best-preserved example, Tomb 101 in S. 101, a coiled basket was placed on top of the body, and a large metate put on top of the burned roof. Such practices are known ethnographically. For example, the Shuar of Ecuador buried an important male in a house in which he has lived and then burned it to the ground. The Makiritare of the Venezuelan Amazon were seen to bury the dead of an epidemic in a house that was burned to the ground. At Paloma, burned houses may have served to mark the claims of lineages to the few highly productive beach sites. These would be the ones with good fishing and access to sweet water and carbohydrate-producing lomas or river.

Besides venerating ancestors with special treatment involving fire, relatives attempted to preserve the remains of all of the dead. We have found that salt, sodium chloride, comprised more than one-half of the volume of the burial fill through research at the Missouri Research Reactor (MURR) by Jeremy Edward (MU dissertation; MU theses and dissertations are not in the bibliography but are available online). As fishermen, Palomans would have been familiar with the preservation properties of salt. The lived only a few from coastal salt deposits. At La Galgada, in the Late Preceramic, large salt crystals covered by a layer of charcoal served as the base for two burials. Salt crystals were found also beneath the head of one of the earliest burials excavated by Terrance Grieder there.

These rituals for venerating and preserving ancestors are related to modern tropical lowland belief systems and prefigure the mummy cult of the Inca by four thousand years. They can be compared with the Chinchorro cult of far southern Perú and northern Chile, where the coast is less distant from the tropical lowlands than it is at Paloma.

Increasing Investment in Children

Jeffrey Quilter, a crew chief in the 1976 excavation, published a good description of Paloma burials. In a nonmetric multidimensional scaling of interments coded for mortuary content by Sharon S. Brock, I found statistically significant differences in the dimension weights by strata that quantified an increasing emphasis on children that Quilter had identified. More elaborate burials for children may have reflected an increasing investment in them. The finding of two newborns separated by a grinding stone could indicate infanticide, another way to invest more in fewer children.

An unusual orientation of the young and, the pattern of interment by gender in the last major occupation at Paloma, may be another reflection of cosmological belief systems from the tropical lowlands.

Male/Female Dualism

In an analysis, Kate Pechenkina, and I conducted of the Paloma burials, we found male in #200 were buried in the eastern part of houses, and females were interred in the west; most infants along an imaginary northeast/southwest line dividing the two (see **Figure 9**). The dimension of gender is a powerful indicator of dualism at Paloma, but this pattern was restricted to #200 burials. The line along the orientation of most infant burials in

Figure 9 could be viewed as tracing the nightly extreme of the Milky Way. We know that later Andeans would see the Milky Way as representing fertility. The importance of astronomical phenomena to early peoples extends to the tropical lowlands where some of the same constellations are recognized as in the Andes. Could these mortuary customs emphasizing dualism and the Milky Way have been brought by new peoples to the coast?

Coastal relations with other peoples

A single bone of a monkey could represent contact with the tropical lowlands. However, this would be very slender evidence in support of significant coastal/lowland relations.

Maria Rostworworski has suggested from ethnohistoric and linguistic studies that there was complete population replacement of central Peruvian coastal peoples by highland peoples at an early time. Highland incursions of the coastal valleys are known from later periods. Studies of the dental traits of the human remains from Paloma by Christy Turner III suggested that the last occupation, #200, was by people with a very different suite of genetically influenced dental characteristics than earlier inhabitants had. However, restudy of a slightly different subset of Paloma teeth by Richard Sutter was unable to confirm those differences. Two different laboratories were unable to extract segments of DNA from samples of bone or brain long enough for analysis. We occasionally excavated obsidian flakes throughout the deposits at Paloma. Through trace element analysis of obsidian, Mike Glascock at MURR found that all but one piece came from the Quispisisa source near the headwaters of the Pisco River. From that location, the highland river systems are directly accessible from the coast. However, in paleoethnobotanical studies, Glendon Weir found no significant plant remains at Paloma

originating from more than 1,000 meters, so movement of obsidian was most likely due to Paloman's chance encounters with highlanders as either group foraged the lower western slopes of the Andes. Absent successful study of ancient DNA, the question of population replacement remains unsettled.

BIOLOGICAL STUDIES AT PALOMA

The primary research for the excavations I directed was directed towards study of the evidence for early sedentism in a system of human/environment interactions in a fragile habitat. Due to excellent preservation, the biological evidence was well preserved. Fuelwood was one organic material that was critical in the arid environment, and it serves as a useful indicator of anthropogenic and natural changes.

Fuelwood and construction materials

The fog oasis, which provided water and plant resources to these early villagers, became degraded over time. We can demonstrate this by changes in fuelwood, charcoalized twigs, and building material. Glendon Weir and Philip Dering found a statistically significant decline in average diameter and variance as well as in quality of the fuel wood that was excavated in our 1976 and 1979 seasons. In order to confirm this pattern, in 1984 Glendon Weir obtained data from a special test excavation into a Paloma midden. **Figure 8** shows levels #100 to #600. Both fuel wood and wood for construction show the same pattern, increasing use until the last village in #200, when use of wood for construction dramatically decreased as its use in fires increased.

The environmental degradation suggested that over exploitation of fuelwood at Paloma at the time when available moisture was decreasing. This trend has been documented by glacial cores from the Huascarán glacier in the central Andes. Inhabitants were forced to remove more of the shrubs from the fog oasis rather than continuing a sustainable harvest of dead twigs and branches. However, no wood from tree trunks was ever used as fuelwood at Paloma. Had the trees themselves been used for wood, the fog oasis vegetation would have quickly collapsed to the degraded state in which we find it today. This is because the trees condense the moisture from the fog that permits the lomas to bloom. In response to a dryer and more variable climate, both maritime and terrestrial resources became more intensively exploited. The beginning of regular but episodic ENSO events after 5,000 BP is known from, among other evidence, changes in mollusks reported by Daniel Sandweiss, and changes in the frequency of different species of fish reported by Elizabeth Reitz. Changes in the lomas were consequential for water production, perhaps the major reason for abandonment. Without water, the site was uninhabitable.

By 4,700, the last Paloma families had moved to the nearby river valley site of Chilca 1 where year-round water was available. They left behind them a record spanning more than three thousand years. The human remains we encountered provided critical information about diet, health, and habitual economic activities. Indigenous Andean peoples today support scientific studies of human remains, perhaps since the Spanish destroyed their ancestral mummies.

HEALTH, DIET, AND ACTIVITIES FROM THE SKELETON AND TEEETH

Health

Surprisingly, health improved over time at Paloma in an environment of steadily degrading terrestrial and increasingly variable marine resources. Stature, one of the best indicators of childhood health, increased significantly over time at Paloma. In a review of health in prehistoric central Perú, Kate Pechenkina and her associates found through study of limb bone lengths that Paloma fishermen were taller as adults than peoples who followed them were. Cross-sectional growth of limb bones during childhood was always faster at Paloma than at three comparative sites, suggesting the stature increase in adults was due to improving childhood health and diet at Paloma. From Pechenkina's study we learn that the stature increase in adults was not paradoxical, which could occur if there had been lower survivor rates for shorter, unhealthy children. In that case, a taller population might result in a population more stressed as children. That was not the case at Stature was significantly higher at Paloma (males 165 cm, females 155 cm) than at Real Alto (males 162 cm, females 151 cm). The inhabitants of the larger Valdivian villages may have suffered from more problems of sedentism than did Paloma.

Another useful indicator of adult health is anemia, which registers first in the bones of children. Anemia declined over time at Paloma but became more prevalent in subsequent time periods. Periosteal lesions on bones, caused by either a treponemal agent or infection following wounds, decreased between levels # 300 and # 200 but increased in sites from following time periods. This pattern for periosteal lesions is quite similar to the one Ubelaker found in Ecuador. The three indicators are consilient at Paloma where health gradually improved, despite the hygienic challenges of sedentary life.

Diet

Diet begins with the teeth, and dental wear decreased significantly over time at Paloma, probably as more processed small fish were eaten. The dental wear pattern of Paloma fishermen was easily distinguished from the cusp-like wear of farmers. Carious lesions, "cavities," were nearly absent in the teeth of these fishermen, with only a few cases noted. These lesions were more frequent at Real Alto where almost 9% of individuals had at least one, a value typical for a high carbohydrate diet. Bone chemistry confirms the dental patterns at Paloma. Stable isotopes are presented in **Figure 10**. This average suggests a diet almost exclusively from the sea. Ba/Sr elemental concentrations in bone (analysis by J.H. Burton) provide identical findings based on a different set of factors, with Paloma values falling into the center of the maritime ranges. Fluoride is abundant in animals from the sea. Levels measured by Jeremy Edward at MURR were high at Paloma, as was expected. He also showed a change in fluoride levels in males, from one higher than females in earlier levels, to about equivalent consumption of the two genders in level 200. This pattern suggests women ate more seafood and probably less gathered or cultivated food in the final occupation. Other lines of evidence characterize subsistence in the final occupation as one more focused on the sea in a degrading terrestrial environment. In an MU thesis, Eric White found that Level #200 was when more than 70% of the batanes were recovered despite the number of structures being approximately equal among the strata. Glendon Weir's study of the contents of the surfaces of the batanes showed their use for both grinding plants but also small fish. Ground fish, with the meal stored in grass-lined pits, would have provided food for both men and women in

ENSO years when marine yields would have been lower. Apparently, the adjustment was successful. The #200 peoples do show improved health. Such improved health could be translated into longer lives.

Paleodemography

We estimated life expectancy from the distribution of the dead by age groups, using plausible levels of population growth rates. Results suggest life expectancy increased over time. Fewer infant burials in #200 argue for greater investment in children, who as discussed above, showed less stunting of growth. The lack of scars of pregnancy in the pubic and ilium bones of women younger than 24 years suggests that marriage was delayed, reducing fertility. High levels of cadmium, abundant in marine fish were observed in human bone samples, and they likely reduced male fertility, perhaps most strongly in #200. Adult life expectancy increased over time at Paloma only to decrease in subsequent time periods at other sites. In Ecuador, in the analysis of Ubelaker, there was also a decline following the Preceramic period. A recent compilation of studies by Mark Cohen shows that a similar decline in health and life expectancy of adults is associated with initial experiments with intensive agriculture in prehistoric peoples around the earth.

Zooarchaeology

Elizabeth Reitz has studied Paloma materials. She found that the diet was one typical of fishermen, an interpretation that accords with that from the bone chemistry and dental patterns. Fish and sea lions were important components of the diet, augmented by shellfish. She noted a shift over time towards smaller species. Reitz found that #400

people obtained 92% of their biomass from fish, followed by a reduction to 67% in #300, when terrestrial resources were probably richer. There was an increase to 82% in level #200 with the dryer climate.

Remains from juvenile sea lions are found. These animals are resident in summer whereas guanaco (ancestral to llamas), deer, and fulmar (a gull-like bird), also present, would have been attracted to the fog oasis in the winter when it blooms. Alternatively, these bones may have been selected cuts from mammals hunted in the upper valleys in El Niño years. Samples were not sufficiently large to permit taphonomic analysis. The single bone from a monkey was from *Atelles spp*. Reitz found that overall, most calories were obtained from the sea; however, plants constituted a minor but important component of the diet.

Paleoethnobotany

The identification of the plant macrofossils recovered from over 100 storage pits and other contexts has been completed by Deborah Pearsall following the earlier work of Glendon Weir and Philip Dering. Pearsall has studied plants from storage pits and other contexts from levels #200 and #300 but not yet #400. She finds plant remains more ubiquitous in #200 than in #300, despite the fact that grass is more visible in the matrix contents of #300. Charred Begonia plants were the most common edible plant in #300. Glendon Weir found evidence that the tuberous Begonia was cultivated; its masticated roots were common. Amancay (*Hymenocallis amancaes*), a lily, was also important. Uncharred Begonia and charred gourd were equally common, with rare examples of charred cotyledon pieces. There is also an unknown charred tuber/root. Gourds became

less common over time. Maize was found in two areas; one was an intrusive offering (dated to more recent times), the other, a single couple. This economically important plant was cultivated at Real Alto.

Pearsall summarizes paleoethnobotanical findings at Paloma as follows: the remains of utilized plants are more common by count/gm of sample in #200 than in #300. One important new food plant appears in #200, Phaseolus, the common bean. Small seeds appeared to be secondary to root and tuber foods in the samples collected from 1 and 0.5 mm screens, possibly because they passed through them. Pearsall noted that every coprolite studied included some plant remains, while many contained the remains of seaweeds, showing a less than completely carnivorous diet.

Human coprolites

Study of plant and animal remains from several hundred desiccated human fecal remains was made by Glendon H. Weir and Phillip Dering. These demonstrated that grass caryopses (grass "fruits" of "seeds") in fact were one of the major plant foods consumed. The smaller seeds apparently passed through our 1 mm and 0.5 mm screens in the samples studied by Pearsall. Seeds of plants other than grasses in the coprolites included chenopods (*Chenopodiacaea*), solanaceous (*Solanacae*), and composites (*Compositae*). Evidence of the preparation of these foods is observed in finding charcoal and fragments of stone in coprolites, perhaps from grinding.

Parasitological studies of large samples of coprolites by two specialists (Karl Reinhard and Michael Kliiks) produced no ova or other indications of intestinal parasites. This finding is puzzling since the common frequency of anemia among people with an

iron-rich diet of seafood suggested such parasites would have been present. Intestinal parasites are common in other, later Peruvian coastal sites. Fishermen may have unusually good sanitary habits. Frequent immersion on the sea would have reduced fecal transmission from person to person. At the site, we found a latrine area composed of coprolites. Some coprolites were adhering to a shell that experiments showed made an adequate substitute for toilet paper.

Taken together, the coprolites, macrofossils of plants, faunal remains, and bone chemistry, identify the diet as one of fishermen who were extracting as much from the fragile terrestrial environment as possible. Indicators of diet predict habitual subsistence activities necessary to produce and process food.

Habitual Activities

Anna McNair studied humeral and femoral shape at Paloma (MU Honor's Thesis). She found statistically significant shifts over time in humeral shape. Humera were wider at the elbow in the early levels and associated with more robust muscular development. This robustness decreased over time at Paloma, a trend stronger in males than in females. More recently, Alexander Robling studied behavior through both bone turnover rates (osteon densities) and cross-sectional geometric properties of the distribution of femoral bone mass around its axis in an MU dissertation. Robling confirmed that there was a decrease in the amount of physical work at Paloma over time. Sexual dimorphism was also seen to diminish so that in #200 women show almost as heavy development of musculature as men, especially in the development of the upper body. Women could have been hauling nets, carrying shellfish the 3.5 km uphill to the

village, breast stroking while pushing nets, or working at greater plant management and collection activities. Auditory osteomas, bony growths produced by exposure to cold water ("surfer's ear"), were restricted to males, which correspond to the pattern observed on the west coast of South America, where men and not women dived deeply for mollusks. These and other habitual activities, mostly concerned with obtaining food, could be reflected in technology; however, the material technology at Paloma was a simple one.

TECHNOLOGY

Artifacts were scarce, with non-fiber objects averaging only a few per cubic meter of excavation.

Lithics

Eric J. White, like Frederic Engel, found no difference in the frequencies of types of the laurel leaf-shaped stone points over time in his MU thesis. However, better lithic material for stone points did become less common over time, a common pattern. Stone points were not frequent at the Paloma villages, and, indeed, they are infrequent in fishing sites from middle and late coastal preceramic periods from Ecuador to southern Perú.

White also noticed a dramatic decline in wood polish in scrapers from #200. This finding is congruent with deforestation of the fog oasis suggested in **Figure 8**. Manos and smaller grinding stones were common. Boiling stones for cooking in gourds were sometimes found in hearths, with their inferior surface caked with carbon. There was usually one batan per household.

Obsidian flakes were encountered occasionally throughout the deposits, and their source was in the highlands, as discussed above. In a single pit, rocks of all the types observed at Paloma were cached together, in the house of the presumed village knapper. A few stone beads were found.

Fiber Objects

Two reports on fiber objects are available in English at the PalomaWorld web site. A more extensive study by Miriam Viajos has been published in Spanish. Twined mats and netted apparel were found around the head and waist of buried individuals. Apart from string and rope, these were the most common fiber objects. All of the fiber was from wild plants, except for the intrusive cotton offering dated much later.

Of special interest is the charred simple basket in the shape of flat circular tray discussed above with S. 101 (upper right corner of **Figure 7b**). Its date of 5000 BP suggests that it may be one of the oldest examples of a true coiled basket known for the Western Hemisphere, which can be distinguished from earlier simple twined objects often reported as "basketry".

Bone Implements

Paloma bone artifacts include points, needles, bullroarers, and fishhooks. Frederic Engel has published a good discussion of Peruvian fishhooks. Thirty-three bodkins, flat spatula-shaped bone objects with a perforation at the proximal end, varied in size and amount of polish. Most were found with burials. Bone spatulas, flat, polished bones lacking a perforation, were sometimes made from sea mammal bone, perhaps reflecting the

scarcity of more suitable land mammal bone. We recovered pendants, punches, and fragments of barbs, as well as "atlatls" or spear throwers. Awls were present. Individual tubular bone beads were flat with a range in size. Twenty-four beads were found as a necklace with Tomb 52, all of which are tubular avian bones. Two bone objects were recovered that may have functioned as knives.

Gourds

Gourds were found principally in burials. Most were undecorated, like those from the Late Preceramic component of the site of Huaca Prieta. One fragment, from S. 36, is quite ancient for such decoration. The fragment has a painted design of brown over an orange background. Gourds were fashioned into rattles, sometimes with a stick handle, worn shell fragments, worn pebbles from the beach, and seeds. There is evidence for rattles in about 20 or the 201 burials and the frequent presence of gourd fragments in other burials suggest the practice of interring rattles was common. At least one infant burial had a complete rattle. Others, recovered in parts, were also found in burials of young adults of both genders. Some gourds had been broken and repaired by sewing segments back together, suggesting the maintenance of an important heritage treasure. Mending thread was sometimes preserved in the apertures made to mend the gourd.

Shell, Wood, and Feathers

Some large shells showed abrasion from use. Shell beads, pendants, and with burials, necklaces were found. A few complete and many fragmentary fishhooks were noted. Wooden stoppers or floats and a handle that may have given purchase to a fishing net

were recovered. One piece of wood was used as a fire drill; other implements of unknown function have not been studied. Fuelwood as a consumable artifact has been discussed above. Split cane was used for fire starters and to construct wall coverings and sleeping/mortuary mats. Penguin feathers were relatively common in burials, presumably as adornments; other feathers were probably plucked from birds that were eaten.

SUMMARY

Villages do not require pottery or intensive plant production to grow and prosper. Early villages such as Paloma in the Western Hemisphere appear to be those of fishermen. The Jomon fishing villages in Japan may be among the oldest villages in the world. Paloma fishermen also cultivated plants. Villages more focused on farming came later, as represented by Valdivian sites such as Real Alto in Ecuador. Valdivia culture continued to have demonstrated continuity over time whereas in central Perú, dramatic changes in settlement pattern and monumentality of structures followed abandonment of the earliest fishing villages.

The tipping point to more dependence on agriculture than fishing occurred later in coastal Perú than in Ecuador. Early Ecuadorian villages were larger than early Peruvian ones. **Figure 11** shows an excavated domestic structure at Loma Alta, which can be compared with the structure from Paloma in **Figure 7b**. **Figure 12** is a reconstruction of the village at Real Alto provided by Jorge Marcos. The depiction is of a later village that had changed from an earlier circular hamlet to a rectangular settlement with a central plaza. This village developed in the centuries after the abandonment of Paloma. The Valdivian sites are associated with substantial numbers of species of domesticated plants

and represent more densely settled population, one less healthy than the Paloman fishermen. Real Alto may serve as a model for an early agricultural village, one in which, nevertheless, initial settlement may still have derived considerable resources from the sea.

Findings from the Paloma Project support the original version of the celebrated hypothesis by Michael Moseley that maritime resources were the critical ones in the development of Andean civilization. The larger Valdivia sites support Moseley's more recent reformulation of the hypothesis, that fishing and farming resources formed part of a dual economy. In Perú, the large, complex monumental sites that followed Paloma date to earlier times than equivalent ones in Ecuador, suggesting that we still do not understand this process fully. The early villages in Ecuador and Perú suggest two paths that permitted populations to grow towards towns and then urban centers. Present evidence favors the MFAC hypothesis, that in South America, resources from the sea and the land permitted very precocious construction, between 5,000 and 4,000 BP, of large, monumental sites such as Chupacigarro/Carál, Aspero, and El Paraíso. The knowledge that permitted this development was acquired over millennia in fishing villages and was used to adjust to the new requirements imposed by the dryer and more variable climate encountered at the ending of the Global Climatic Optimum about 5000 years ago. Cotton was domesticated at this time after the abandonment of fog oasis sites and resettlement in river valleys. Increased farming of agricultural products may have been pursued with increased farming of marine economic products such as gourds for floats and cotton for nets. With these products, yields of fish could have been dramatically increased over a wider variety of beach habitats.

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