hawaiian archaeology 5

Volume 5, 1996
Society for Hawaiian Archaeology

hawaiian archaeology

Volume 5, 1996

Society for Hawaiian Archaeology

hawaiian archaeology 5

Sara Collins, Editor

Production of this volume was made possible with the generous financial assistance of:

Robert E. Black Memorial Fund

ISSN 0890–1678

Editor's Note

The fifth volume of *Hawaiian Archaeology* attains several goals. First, Volume 5 is a thematic issue of the journal, structured around papers in Hawaiian skeletal biology and related topics. Although these papers do not fill the Volume 5, the several articles on burials and skeletal biology represent a range of work being done in Hawai'i today, and the authors provide direction for future research. Second, the very last of prior contributions, received in the 1980s, now appear on these pages. Third, we have included two new types of articles: an obituary and a review. While we hope that occasions requiring the former will be few and far between, we are hopeful that future volumes of *Hawaiian Archaeology* will carry reviews of books, journals, and monographs of importance to the professional communities who work in and with Hawaiian archaeology.

Chinn Ho, businessman and financial supporter of the Mākaha Valley Historical Project, passed away in 1987. As Yen makes clear, however, Chinn Ho's contributions live on in the form of fieldwork and research publications that even yet set standards for contract archaeology in Hawai'i. Somers' research report on two human burials recovered from Kalaupapa in the mid 1980s provides a nice mixture of data and literature review which allows us to see the larger pattern in the smaller case study. Pietrusewsky's and Douglas' careful study of deliberate fragmentation of human remains has yielded unexpected results which should prompt cautious interpretation of such finds. Trembly provides a thoughtful discussion of skeletal evidence for the presence of tuberculosis prior to western Contact and its meaning for Hawaiian health. Interestingly, her hypotheses devolve in part upon native Hawaiians as active players in their world, rather than passive victims upon whom European diseases are visited. Kirch and Van Gilder give us an overview of the archaeology of the Kahikinui District on Maui. They have built quite successfully on previous fieldwork and reports completed in the 1960s and 1970s; their work of the 1990s more than fulfills the promise of the earlier work. Finally, Dye gives us a brief review of a new and promising journal in a sister discipline: *Journal of Hawaiian and Pacific Folklore and Folklife Studies.*

In accepting the editorship of Volume 5, I hoped to bring skeletal and burial studies back into the mainstream of scholarship in Hawaiian archaeology. I am heartened by the response to a call for such papers and hope that those included in Volume 5 will both inform and assist in making appropriate and timely decisions concerning burial treatment and disposition. S.C.

Obituary for Chinn Ho

Douglas E. Yen

Honolulu, Hawai'i

Among the many tributes to the memory of Chinn Ho who passed away on May 12, 1987, missing has been any reference to his role in the development of field archaeology in the State of Hawai'i. Indeed this was but a small part of his active life as financier, developer, and philanthropist, but its result was to become a model of procedure for archaeological research through private funding. I refer to the Mākaha Valley Historical Project that began in 1968.

Mr. Ho's company was to build a hotel at the mouth of the Valley, and knowing something of the cultural importance of the Wai'anae area in Hawaiian tradition, he felt that an interpretation of Mākaha's prehistory through the uncovering of archaeological sites would enhance the prestige and appeal of his enterprise. He was intrigued by Kāne'ākī Heiau across Mākaha Stream and up-valley from the hotel site, but he soon learnt that little more information could be added to the archaeological record. Thus, typically, he set about acquiring it. For help he contacted the Department of Anthropology at Bishop Museum, and he could not have drawn a tougher negotiator than the already eminent archaeologist Roger C. Green to represent the interests of Hawaiian prehistory. It was a case of a meeting of the doyen of business in Hawaii with the doyen in the business of research! It was also a meeting of the minds, for from different directions both wanted the same thing—the most comprehensive investigation that resources would allow. Thus, an agreement was forged whereby Roger would deliver the scientific results and Chinn the financial backing through the Mākaha Historical Society.

As with most major undertakings in contract archaeology, the "scope of work" was difficult to anticipate—especially remembering that the Mākaha project was the first of its kind. Thus, toward to the end of the two-year fieldwork, the archaeol-

ogists made a case for continuation. Mr. Ho, after reviewing the 1968 and 1969 results, appointed his son Dean to take care of the additional and unexpected refinancing, indicating his mark of approval of the achievements of the project. Such flexibility in contract archaeology is decidedly rare, especially in the private sector which too often seeks the minimum to conform with environmental and cultural impact regulation.

In 1970 Roger Green regrettably departed the Museum for New Zealand but the administration of fieldwork was left in the capable hands of Edmund Ladd, on secondment from the National Park Service since the inception of the Mākaha research—an acknowledgment of the national importance of the project. Among the advanced students in archaeology who participated in the project as part of their training, leading to their future recognition as professional archaeologists in Hawaii and further afield, were Robert Hommon, Patrick Kirch, Tom Riley, Paul Rosendahl, Jun Takayama, and the late Chet Gorman.

The following summary of the results of the Mākaha Valley project is based on a 1973 report by Ed Ladd:

1. The entire *ahupua'a* of Mākaha was surveyed for archaeological sites.

2. Archaeological structures and features which formed clusters and cluster groups from the dry, lower valley and the wet, upper valley, representing three functional categories—economic, residential, and religious—were located, recorded, and selectively excavated.

3. Research into economic and land-use patterns was conducted.

4. The reconstruction, restoration, stabilization, and interpretation of certain areas were carried out.

In carrying out these objectives, the Mākaha Valley Project participants also set high standards for future work by achieving several "firsts" in Hawaiian Archaeology. The Mākaha Valley Project marked the first time archaeological field methods were used to investigate an agricultural complex. The excavation and of the Kāne'ākī Heiau site was the first systematic study of architectural changes through time in this important site type. The resulting interpretative plan for Kāne'ākī Heiau, developed in consultation with the Mākaha Historical Society, led to the complete restoration of the most prominent religious site in the valley.

The Mākaha Valley Project resulted in the publication of five research reports in the Pacific Anthropological Records series (PAR) of the Bishop Museum's Department of Anthropology. The first two in 1969 and 1970 edited by Green (PAR 4 and 10), the third in 1972 edited by Ladd and D. E. Yen (PAR 18), the fourth in 1973 by Ladd (PAR 19), and the fifth in 1980, written by Green (PAR 31). Support for this publication program was built in as a condition of the original project agreement, an uncommon provision in private contract archaeology. Chinn Ho's commitment to the research was such that when we at the Museum sought to publish Roger Green's synthesis of the whole project long after its completion, Mākaha Before A.D. 1800 appeared in 1980 as PAR 31 with the financial assistance of the recently formed Chinn Ho Foundation.

In this account, I have tried to balance the financial aspect of Chinn Ho's participation in the Mākaha research with the archaeological results in which his absorption went far beyond any possible commercial motives for his support. He appreciated the scientific value of the findings and the necessity of their communication; he knew that he was contributing to archaeology in providing field experience to many younger participants. Throughout his career, Chinn Ho was a trendsetter—and characteristically this project was a demonstration to his, to this day, slower-learning colleagues of how contract archaeology should be done! Underneath all of this, however, was his respect for Hawai'i and the Hawaiian past; his perception of the instrumentation of the Mākaha Project was as one tangible expression of that deep feeling.

Two Human Burials from Kalaupapa, Moloka'i

Gary F. Somers

National Park Service, Alaska

In February 1986, high surf washed two human burials out of the sandy beach northeast of Molokai Lighthouse, and southeast of Kahi'u Point at Kalaupapa National Historical Park (KNHP), Moloka'i (Fig. 1). First, an isolated skull had been found along the beach and turned in to the National Park Service KNHP office. Secondly, a survey of the same beach area located an isolated mandible and Burial 1. The mandible lay on the surface of the sand about 115 m southeast of the skull. Like the skull, the mandible appeared to have been washed out from somewhere else and been re-deposited in its recorded location. Burial 1 was located 34.5 m southeast of the mandible. During the excavation of Burial 1, a second survey of the surrounding beach located Burial 2. Figure 1 shows the relative locations of the isolated remains and the primary interments of Burials 1 and 2.

Burial 1

Exposed bone revealed the location of Burial 1. Ten cm of the proximal end of the left humerus were exposed above the surface of the sand by high surf. The burial lay in a flexed position on its right side, with the head oriented to the southeast. The skull and mandible, and the bones of the neck and shoulder region (cervical vertebrae, clavicles, and most of the scapulae) were missing. The left arm lay on top of the legs, the right arm was between the legs, and the hands were by the feet. The burial pit was 70 cm long, 46 cm wide, and had a maximum depth of 30 cm.

Subsequently, the *in situ* remains of Burial 1, and the isolated mandible and skull were shown to come from one individual: "... the skull and infracranial remains are a probable match based on similarities of age and sex" (Pietrusewsky 1986).

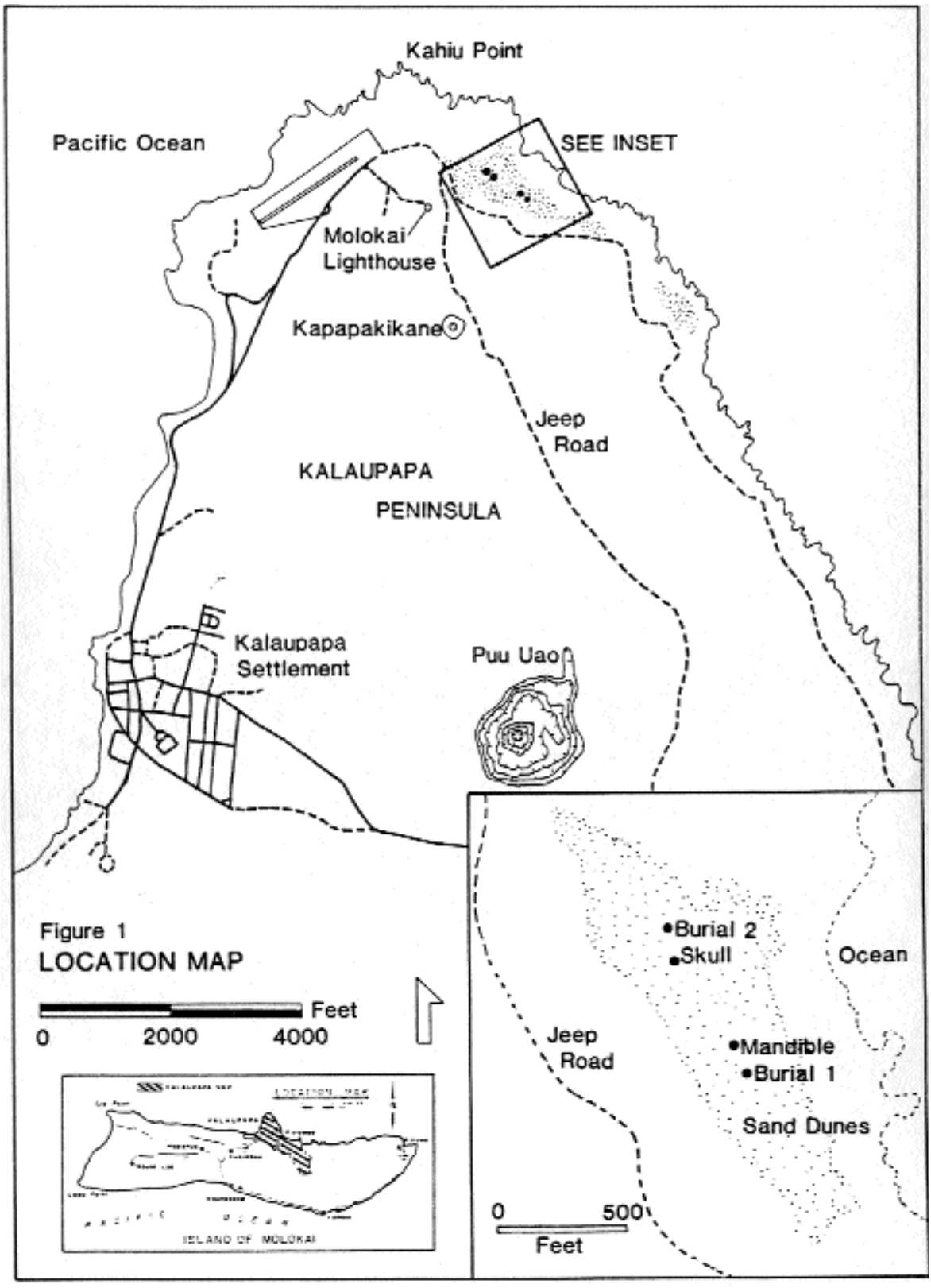


Figure 1
LOCATION MAP

The most conclusive evidence that the isolated cranial portions were derived from Burial 1 was the presence of maxillary left and right central incisors found with the burial deposits. These two teeth were missing postmortem from the skull when it was recovered. The two central incisors found with the burial were consistent in size and condition with the other maxillary teeth, and they fit into the alveolar sockets of the maxillae.

Although no artifacts were found with Burial 1, a nearly complete skeleton of a young bird was found in front of the right tibia of the human skeleton. Dr. Alan Ziegler identified the bird bones as being those of a young (a few weeks old) *Gallus gallus* (Jungle Fowl or *moa*). According to Dr. Ziegler (pers. com., 1986), the Jungle Fowl brought to Hawaii by the Polynesians, and the Domestic Chicken are both *Gallus gallus,* and their skeletons are indistinguishable, especially when they are as young as this specimen. The significance of the *moa* skeleton associated with Burial 1 will be discussed below.

The human remains in Burial 1 were those of a young adult female, aged about 21–25 years at the time of death; she stood about 5 feet, 7 inches tall. All skeletal indicators of biological affiliation—such as a rocker jaw and shovel-shaped incisors—suggested Polynesian ancestry. The cause of death could not be determined, and there was no evidence of infectious disease, such as Hansen's Disease, in the remains (Pietrusewsky 1986: 2–5).

Burial 2

As mentioned above, Burial 2 was discovered during the excavation of Burial 1, and high surf had also partially exposed the skeletal portions of Burial 2. The distal ends of the femora and the proximal ends of the tibiae were visible above the surface of the sand. The patellae were missing and had presumably been washed away. Otherwise, the skeleton was complete and extremely well preserved. The skeleton lay in a semi-flexed position, on its back, the head oriented to the south. The skull had been tilted forward and slightly to the right side and faced southeast. The left arm came straight down the left side of the skeleton and bent across the body at a 65 degree angle at the elbow. The left hand was on the right side of the skeleton between the pelvis and the ribs. The right arm came straight down the right side of the skeleton and bent back upon itself at the elbow. The right hand was on the right shoulder. The burial pit was 78 cm long, 31 cm wide, and had a maximum depth of 50 cm. The body's position is consistent with the pattern Robert Bowen observed at Mōkapu, Oʻahu (Bowen 1961).

Thin, dark stains were present in the sand to the right (east) of the right shoulder, below the head, below the pelvis, under the feet, and to the left (west) of the left elbow. The stains ranged in depth from 7.5 to 17 cm below the skeleton and were both directly below and as much as 20 cm out from the skeleton. Bowen (1961) reported carbon traces being found in the regions of the head, neck, shoulder, chest, abdomen, and pelvis in sand burials at Mōkapu, Oʻahu. He described these traces as consisting of darkened, carbon-covered sand that probably resulted from decomposing body tissues and associated grave objects such as pandanus leaf mats, tapa, and cordage. The dark stains in the Burial 2 are consistent with what Bowen observed, and may have resulted from the same taphonomic processes.

Below the skeleton and carbon-stained sand layer of Burial 2 were six rocks ranging in size from boulders (greater than 25.6 cm in breadth) down to cobbles (between 6.4 and 25.6 cm in breadth). These rocks had possibly been placed in the bottom of the burial pit, but it is more likely that they occurred there naturally. This portion of the beach is very rocky and whoever interred Burial 2 probably dug down into the sand until rocks were hit. The skeletal remains found in Burial 2 were those of a female aged 50 years or more at the time of death. She stood about 5 feet, 2 inches tall, and was probably of Polynesian ancestry. The cause of death could not be determined, and there was no evidence of infectious disease, such as Hansen's Disease, seen in the remains (Pietrusewsky 1986).

Discussion

The two excavated burials at Kalaupapa were both buried in sand; one was flexed and the other was

semi-flexed. Disposal of the dead by burying them in the sand was a common practice throughout the Hawaiian Islands (cf. Bennett 1971; Bowen 1961; Emerson 1902; Emory 1969; McAllister 1933; Stokes 1957; Summers 1971). According to Bowen:

> The high concentrations of burials in sand environments, particularly where dunes exist, indicate that these areas were set aside for the dead and may have been used for long periods of time. Dunes were waste areas incapable of food production and were usually some distance from residences. Digging was easy and preservation of bone material was generally excellent (Bowen 1961: 129–130).

Bennett described sand dunes "as the most convenient location for quick burial" and concluded that they were "mostly, though not exclusively, used by the common people" (Bennett 1971:26).

Burial in the flexed position was also a common practice in Hawaii in pre-Contact times (cf. Bennett 1971; Bowen 1961; Emory 1969). John Stokes (1957) associated the flexed position with pre-European times, and both Donald Tuohy (1965) and Edmund Ladd (1986) attributed earth disposal in open sites with the body in a flexed, semi-flexed, or semi-extended position to an "older pattern" of disposal of the dead. William Ellis (1979:258) and David Malo (1980: 97) both described the flexed position when they discussed burial methods and both of these authors were describing burial practices that were in use prior to missionary influence. Although burial in the flexed position was more common, the semi-flexed position has been previously documented as well (see Bowen 1961). Certainly, the two burials from Kalaupapa are consistent with these patterns of disposal of the dead practiced in prehistoric Hawaii. The significant, and uncommon, feature of the Kalaupapa burials is the presence of the *moa* remains found with Burial 1.

The presence of the *moa* remains may indicate a pattern too, however. Skeletons of domestic or wild fowl (*Gallus gallus*) were found with four burials at Mōkapu, Oʻahu; two of the burials were in the flexed position and two were semi-flexed. In all four burials the human remains were those of adult females while the chicken skeletons were complete or nearly complete, and represented immature birds (Bowen 1961). Burial 1 at Kalaupapa was an adult female, the *moa* was immature and its skeleton was nearly complete. Like the Mōkapu burials, Burial 1 at Kalaupapa was interred in sand.

The *moa* had a number of recorded uses: food for the living (Ball 1933; Handy & Handy 1972; Hiroa 1964; Malo 1980); food to accompany the dead (Bowen 1974; Hiroa 1964); recreation, as in cockfighting (Ball 1933; Malo 1980); medicinal, in treating the sick (Ekaula 1865); religious, as in offerings made at *heiau* or to family gods or associated with *kuni,* or association with ancestral gods (Cox 1974; Handy & Handy 1972; Hiroa 1964; Malo 1980); a source of wealth (Malo 1980); pets (Daniela 1962); and toll payment for crossing the Wailuku River (Ellis 1979). Could any of these recorded uses explain the presence of immature chicken skeletons in the burial pits of adult female Hawaiians?

The recorded history of Hawaiians' use of *moa* for food is somewhat contradictory. According to Malo (1980:41, 78), domestic fowl made excellent food and were in great demand by both chiefs and commoners. Te Rangi Hiroa (1964:3) also mentions the importance of domestic fowl as food. In citing Lieutenant James King of the Cook Expedition, Handy and Handy (1972:256–7) concluded, however, that the Hawaiians probably regarded chicken "as second-rate fare because chicken meat steamed in an *imu* is less flavorful for eating with *poi* than is good fish." Bowen (1974:143) and Hiroa (1964:570) suggest that chickens may have been buried with the dead by family members as a food offering. According to Pukui *et al.* (1972:136), "in *hoʻomoe pu* [put to sleep together] various articles were buried with the body as comfort and sustenance in the mystical world. In long-gone times, this might be food." One of those foods, according to Bowen (1974:141), was chicken. One problem exists, however, with interpreting the presence of *moa* remains in these women's burials as food for the dead. William Ellis noted the following food prohibitions:

> The flesh of hogs, *fowls,* turtle, and several kinds of fish, cocoa-nuts, and almost everything offered in sacrifice, were tabu to the use of the gods and the men; hence the women were, except, in cases

> of particular indulgence, restricted from using them (1979:279, emphasis added).

Although none of the other primary or secondary sources on the Hawaiian *kapu* system specifically mention chicken as a food forbidden to women (cf. Valeri 1985), there is indirect support for Ellis' statement. Alexander Campbell (1967) says that "dog's flesh and fish were the only kinds of animal food lawful for them [women] to eat. . . ." Kepelino also stated that all food items that were dedicated to the gods were forbidden to women (Beckwith 1932:64). Valeri (1985:118) notes that the sacrificed species were forbidden to women. Since chicken or fowl appears to have been a food forbidden to women in Hawaii, it seems unlikely that chickens would have been buried with females as a form of provisions. To date, all of the burials recorded as having a complete or nearly complete *moa* skeleton have been those of adult females. Another explanation of this association needs to be sought.

Chickens were a well-known sacrificial species, and were sacrificed as *kuni* offerings, at times of protracted sickness, and as offerings to temple and family gods (Malo 1980:101; Ellis 1979:202). The *moa* was thought to be a form of the *mo'o* (reptile) class of ancestral gods (Handy & Handy 1972:256). The use of fowl as *kuni* offerings also does not explain the presence of *moa* remains in human burials. After the offering (either fowl or pig) had fulfilled its prescribed function, the carcass was thrown into the fire and reduced to ashes (Ellis 1979:203; Malo 1980: 102). Consequently, there would be no bird remains to bury with the human decedent.

Daniela (1862) mentions that pets might accompany their human masters to the grave, and specifically mentions dogs, pigs, and hens. Bowen (1974) questions this explanation for the presence of chickens in females' burials at Mōkapu, noting that all of the bird skeletons were those of immature individuals. Bowen (1974) assumes that the pet-master relationship would be relatively long-term, thus indicating the presence of adult animals rather than immature or juvenile ones.

The use of fowl for cock-fighting also fails to explain the association that is present in the burials at Mōkapu and Kalaupapa. According to Malo, "cock-fighting (*haka moa*) was a very fashionable sport with the *ali'i"* (1980:230). There were no indications, such as the *palaoa,* reported by Bennett (1971), of any of the females' burials having such artifacts.

Two of the other recorded uses of *moa* can also be dismissed as explaining the association of the bird with females' burials. First, Hawaiians perceived chickens as a source of wealth because the *moa* was a desired food (Malo 1980). Since chickens were forbidden to women, the bird interred with Burial 1 does not represent a symbol of posthumous wealth. Secondly, the perceived value of the *moa* did, in some instances, transform the bird into a currency of sorts. William Ellis (1979) records that chickens were used as toll payment for crossing the Wailuku River on Hawai'i Island. It does not seem likely that the *moa* interred with Burial I from Kalaupapa was representative of currency.

The *moa* had two other uses in traditional Hawaiian society, and neither function can be dismissed entirely. First, the chicken was used in medical treatment of the sick. Secondly, chickens were used as offerings to temple and family gods. According to Kamakau:

> When a man died, the *kahuna 'aumakua* of the dead person came and performed his ritual of offering a pig (*pua'a uko*), or if not a pig, a chicken (*moa 'aumakua*), to make acceptable (*ho'omaika'i*) the soul of the dead person to live together with his *'aumakua,* the ancestral gods (1964:33).

Although this statement provides support for the association of chickens with ancestral gods and the dead, it does not contain enough detail to explain the particular occurrence of immature chickens being buried with adult female humans. None of the other sources consulted, including the Hawaiian Ethnographic Notes at Bernice P. Bishop Museum, contained sufficient information to support or refute any of the explanations put forward here. All that can be said at the present time is that this apparent burial pattern has been recorded on at least two islands, and no satisfactory explanation of its occurrence has been found.

Acknowledgments

I am grateful to Dorothy Balderama and M. Melia Lane for their assistance with the fieldwork, to M. Melia Lane for her assistance with the graphics, and to Jaynee Nakamura for typing the manuscript.

References

Ball, Stanley C. 1933. *Jungle fowls from Pacific Islands.* B. P. Bishop Museum Bulletin 108. Honolulu: Bishop Museum Press.

Beckwith, Martha W., ed. 1931. *Kepelino's traditions of Hawaii.* B. P. Bishop Museum Bulletin 95. Honolulu: Bishop Museum Press.

Bennett, Wendell C. 1931. *Archaeology of Kauai.* B. P. Bishop Museum Bulletin 80. Honolulu: Bishop Museum Press.

Bowen, Robert N. 1961. *Hawaiian disposal of the dead.* M.A. thesis, Department of Anthropology, University of Hawaii, Honolulu.

———. 1974. Mōkapu: Its historical and archaeological past. Appendix A In *Early Hawaiians. An initial study of skeletal remains from Mōkapu, Hawaii,* by Charles Snow, 129–148. Lexington, KY: University Press of Kentucky.

Campbell, Archibald. 1967. *A voyage round the world from 1806 to 1812.* Honolulu: University of Hawaii Press.

Cox, J. Halley. 1974. *Hawaiian sculpture.* Honolulu: The University Press of Hawaii.

Daniela, W. P. 1862. Body buried with a live dog. Hawaiian ethnographic notes I:3144. B. P. Bishop Museum Library, Honolulu.

Ekaula, E. 1865. Ancient practices XXVI. Hawaiian ethnographic notes. Thrum No. 43. B. P. Bishop Museum Library, Honolulu.

Ellis, William. 1979. *Journal of William Ellis.* Honolulu: Charles E. Tuttle.

Emerson, N. B. 1902. A preliminary report on a find of human bones exhumed in the sands of Waikiki. *Annual Report of the Hawaiian Historical Society* 9: 18–20.

Emory, Kenneth P. 1924. *The island of Lanai: A survey of native culture.* B. P. Bishop Museum Bulletin 12. Honolulu: Bishop Museum Press.

Handy, E.S.C. and E. G. Handy. 1972. *Native planters in old Hawaii.* B. P. Bishop Museum Bulletin 233. Honolulu: Bishop Museum Press.

Handy, E.S.C., M. K. Pukui, and K. Livermore. 1931. *Outline of Hawaiian physical therapeutics.* B. P. Bishop Museum Bulletin 126. Honolulu: Bishop Museum Press.

Hiroa, Te Rangi. 1964. *Arts and crafts of Hawaii.* Honolulu: Bishop Museum Press.

Kamakau, S. M. 1964. *Ka po'e kahiko. The people of old.* Honolulu: Bishop Museum Press.

Ladd, E. J. 1986. Test excavations at sites B-105, B-107 and B-108: Archaeology at Pu'uhonua o Hōnaunau National Historical Park, ed. G. F. Somers. *Publications in Anthropology 34.* Tucson: Western Archaeological and Conservation Center.

Malo, D. 1951. *Hawaiian antiquities.* 2d ed. Trans. N. B. Emerson. Honolulu: Bishop Museum Press.

McAllister, J. G. 1933. *Archaeology of Oahu.* B. P. Bishop Museum Bulletin 104. Honolulu: Bishop Museum Press.

Pietrusewsky, M. 1986. *Two skeletons from Kalaupapa, Molokai: An osteological analysis.* Typescript on file, Pacific Area Office, National Park Service, Honolulu.

Pukui, M. K., E. W. Haertig, and C. A. Lee. 1972. *Nana i ke kumu,* Vol. I. Honolulu: Hui Hanai.

Stokes, J.F.G. 1957. Archaeological features of the Puuhonua area. In *The natural and cultural history of Hōnaunau, Kona, Hawaii: The cultural history of Hōnaunau,* ed. E. H. Bryan, Jr. and K. P. Emory, 163–223. Departmental Report Series 86–2. Honolulu: Department of Anthropology, B. P. Bishop Museum.

Summers, C. C. 1971. *Molokai: A site survey.* Pacific Anthropological Records 14. Honolulu: Department of Anthropology, B. P. Bishop Museum.

Tuohy, D. 1965. Salvage excavations at City of Refuge National Historical Park, Hōnaunau, Kona, Hawaii. Typescript on file, National Park Service, Pacific Area Office, Honolulu.

Valeri, V. 1985. *Kingship and sacrifice.* Chicago: The University of Chicago Press.

Cultural Alteration of Human Bone In Hawaiian Skeletal Remains

Michael Pietrusewsky
and Rona M. Ikehara-Quebral

Department of Anthropology,
University of Hawai'i at Manoa

Previous studies of human skeletal remains from Hawai'i have reported the practice of deliberate bone alteration. Bowen (1974) provides some of earliest and more detailed descriptions of burial vandalism in two burials from the Mōkapu Peninsula on the island of O'ahu.

> In burial C-43 the distal and proximal ends of all arm and leg bones, accompanied by a large quantity of shaft fragments from the same bones, were found lying in an oblong pile directly under the upper back of the individual. . . Since the long-bone fragments lay under the skeleton, the body had evidently been taken from the pit before the long bones were removed. In order to remove the body intact, decomposition could not have been complete. . . .
>
> Apparently, the long bones were removed after the body was taken from the pit. As the hands and feet were found articulated, but in unnatural positions, they were evidently severed from the arms and legs, either before or after the latter were separated from the trunk. . . .
>
> The vandals pounded the entire shafts of all twelve long bones into fragments, leaving only the distal and proximal ends intact. . . . An examination of the bone fragments present shows that larger flat pieces are missing and thus were the ones most desired by the grave-robbers. Unwanted small fragments, narrow slivers, pieces of curved areas, and distal and proximal ends were thrown into the empty grave.
>
> Following fragmentation, the body, lacking appendages, was apparently returned to the grave, on top of the pile of fragments, the basalt cutting tool was thrown

> on top of the abdomen, and the hands and feet were placed on top of the trunk. . . .
>
> A second male (N-6) was treated in a similar manner. In this case, the complete and articulated body, lacking appendages, lay on the back with the head turned sharply to the left. All long bones of both arms and legs had been removed and fragmented, and lay in a pile on the right side of the body. The pile contained the distal and proximal ends of both femora, the distal and proximal ends of the right humerus, and the proximal ends of the radii. As with the first burial, most of the pile consisted of unworkable fragments. . . . The articulated hands and feet lay in what may have been natural positions on top of the body. One hand was next to the left side of the face and the other lay on the chest. Both feet were in the abdominal area. (Bowen 1974:144–145).

It was Bowen's belief that the positioning of the fragmented bones and the unnatural position of the hands and feet, were indications that the body had been removed prior to complete decomposition. The association of knife-sized and fist-sized basalt tools with these remains were further noted. Bowen further speculated that some of the larger flat pieces of the long limb bone shafts were missing, the kind of raw material that would have proved attractive for fishhook manufacture.

Since these detailed descriptions by Bowen (1974) and Snow (1974) of bone alteration in the remains from Mōkapu, other examples of intentional bone fragmentation and bone removal have been documented in Hawaiian skeletal series by other researchers (e.g., Tuohy et al. 1987, Collins 1986, Pietrusewsky and Douglas 1989a, Pietrusewsky et al. 1991).

Recently, the authors had an opportunity to examine a small series (approximately 27 individuals) of Hawaiian skeletal remains. In this series three individuals exhibited evidence of deliberate bone fragmentation, or cultural alteration of bone, similar to that described by Bowen (1974). This paper reports these three new cases of bone alteration and reviews other examples of this cultural practice in skeletal series from Hawai'i. Finally, we examine possible explanations for the practice through a review of the ethnohistoric and archaeological literature.

Present Study

The presence of debitage (or many small pieces of fragmented bone) representing the shafts of one or more long limb bones, often associated with the complete ends of bone, serves as the principal criterion to identify the alteration of human bone in the present study. The bone debitage is usually associated with a disturbed primary or secondary burial, although it may also represent an isolated archaeological feature. Other archaeological evidence, such as associated cutting or shattering implements and basalt tools, strengthens the assertion that the human skeletal remains had been culturally modified. We specifically exclude defleshing cut marks, or marks which result when muscles, tendons and ligaments are cut in order to remove the flesh from the bones in preparing the body for burial, and other cultural practices such as the retention of bones as keepsakes. Malo (1951:98–99), and other early Hawaiian scholars, for example, have described the custom of retaining certain bones, usually the skull and several long limb bones, as keepsakes by family members.

In the present skeletal series, the long limb bones of three individuals were found to exhibit systematic fragmentation. All three cases resulted in the complete, or nearly complete, reduction of the long limb bone shafts to many fragments, while the proximal and distal ends of these bones were left, more or less, intact. The fragmented portions of these skeletons were found to have been reinterred with the primary burials.

In the first example, all the long limb bones of the arm and leg bones of a 45–50 year old male were deliberately reduced to small bone fragments and then redeposited within the original grave (Fig. 1). The archaeological excavation of this individual indicates it had been originally placed in an extended position in the grave. Subsequent to the interment, the grave had been opened and the body exposed and disturbed. The skull had been removed, fractured, and much of it was found to be missing at the time of examination. Except for a few bones, the entire upper left portion of the individual's body had been removed. The bones of the left arm were reduced to many small fragments and re-deposited

Figure 1. Some of the fragments of the long limb bones which were re-deposited with the rest of the remains of a 45–50 year old male described in the first example.

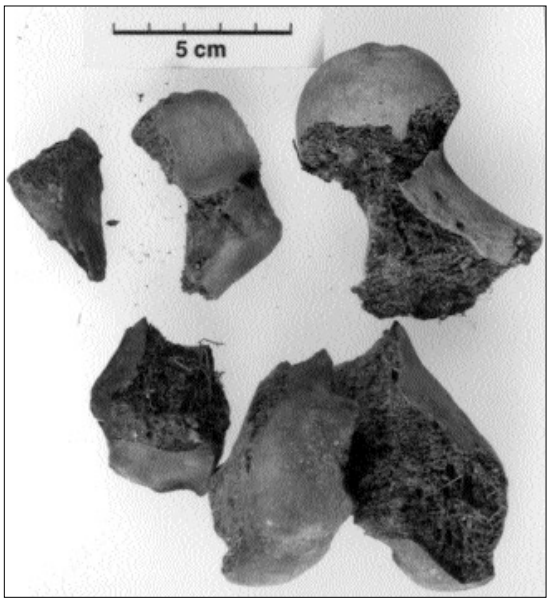


Figure 2. The relatively complete articular ends of the left leg bones described in the first example.

within the grave. The long limb bones of the right arm were similarly removed and broken. The upper right shoulder and thorax region, however, were relatively intact and not disturbed. Similarly, both hands were found articulated where the arms had been removed. The long limb bones of both legs, of this same individual, had been removed and reduced to many small fragments. The archaeologists identified several battered igneous stones, along with stone waste flakes, among the fragmented bones, suggesting that these may have been the tools used to reduced the bone to fragments. The proximal and distal ends of most of the long limb bones were identified in the secondary bone fragment deposits found with these remains (Fig. 2). The hipbones, sacrum, and several other bones were not identified in the laboratory, suggesting they had been removed from the burial site by those who had initially disturbed the burials.

A detailed examination of these remains indicated the presence of more than 500 measurable limb bone fragments, which ranged in size from approximately 12 mm to 61 mm. The majority of the fragments are 20–30 mm in length. The shapes of the majority of these fragments is roughly rectangular. The weight of the individual fragments ranged from 0.2 to 10 gm. In addition to the measured fragments, more than 450 smaller fragments, too small to measure or weigh individually, were identified. The combined weight of the latter is approximately 69 gm. The total weight of all bone fragments from this burial is 602 gm. Typically, the fragments are sharp-edged and angular, or helical, in shape, suggesting that the bone was smashed perimortem (around the time of death), or at least before the bone had become completely desiccated. Using a magnifying hand lens, no obvious cut marks were identified in the broken sections of the bone. The absence of distinct cut marks, as well as chipping and breakage around the surface of these fragments, suggest that they had been broken, or smashed, using a large hard object. Further research will be necessary to reconstruct the broken shafts of these bones which, in turn, will allow a possible determination of which portions, if any, of the shafts are missing and the manner in which they were broken. The sheer quantity of shaft fragments in this example suggests that very little of the original bone had been removed.

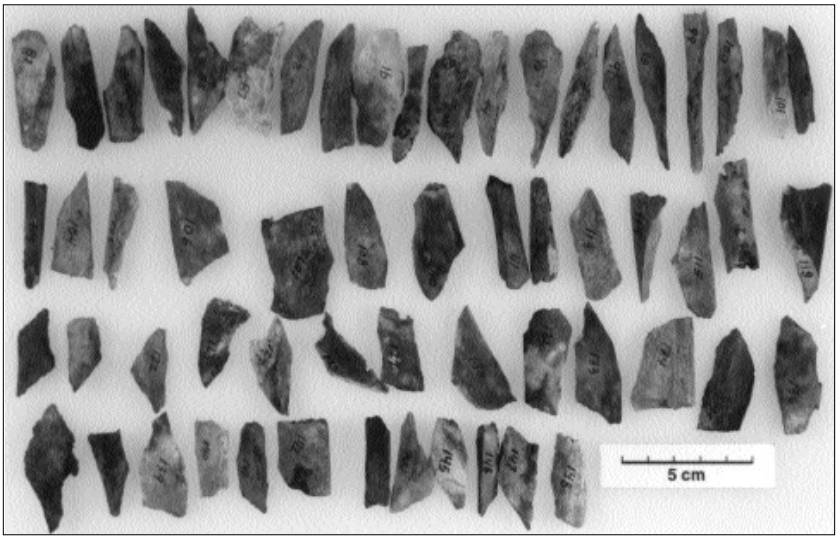


Figure 3. A few of the larger bone fragments found to be associated with two vandalized burials described in the present study.

The next two examples involve a single, but complicated archaeological feature containing the remains of at least two adult males. As in the previous example, the long limb bones in these two burials exhibit breakage and secondary redeposition. According to the excavators, the first burial (Burial 1), a 40–45 year old male, contained no leg bones (femora, tibiae, or fibulae) or arm bones (humeri, radii, and ulnae). Burial 2, secondarily placed in the grave in a disarticulated manner, was missing the same long limb bones. Beneath the secondary bundle of remains that corresponded to Burial 2, a small pit was found to contain what were assumed (and later confirmed in the laboratory) to be the battered remains of the long limb bone shafts of both burials. The remains of the distal and proximal ends of several long limb bones were further identified among these fragments. Excavation of this burial feature revealed that a portion of Burial 2 was located beneath Burial 1 indicating that Burial 1 had been placed in the grave first and was then later partially removed to make room for Burial 2. The portion of Burial 1 that had been removed, prior to the interment of Burial 2, was then returned to the grave so that it was now on top of Burial 2.

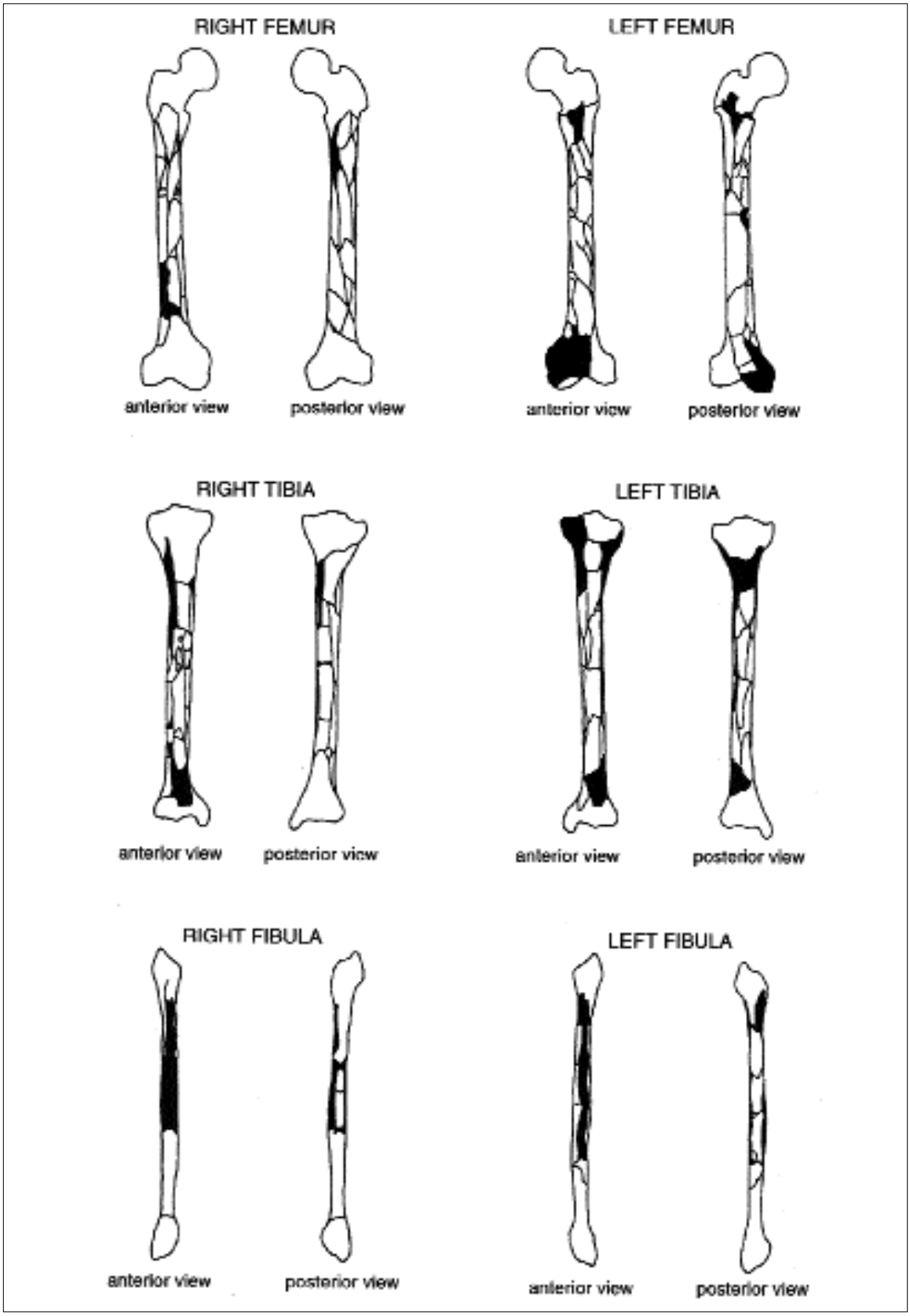
In the laboratory, it was determined that the skull of Burial 1 was mostly present but in many small pieces, which had been broken post- or perimortem. Very few bones of the infracranial skeleton of this burial could be identified in the laboratory. However, the proximal and distal ends of the left humerus and the long limb bones of both legs were identified. The radii, right humerus, and the shaft portion of the left humerus were missing and not identified in any of the associated shaft fragments.

Except for portions of the face and basal region, Burial 2 is represented by a relatively complete skull. The infracranial remains for this burial include scapulae fragments, clavicles, humeral heads, some vertebral and rib fragments, patellae, hipbones, hand and foot bones, and the proximal and distal ends of the femora and tibiae. The arm bones of the second individual were not identified nor were they found to be present among the small shaft fragments associated with this burial feature.

The total number of larger fragments for this burial feature is 438 (Fig. 3). The combined weight of the latter is 811 gm. The largest fragment measures 102 mm in length and weighs 10 gm. The smallest fragment measures approximately 14 mm and weighs 0.4 gm. In addition to these larger fragments, 302 smaller fragments, weighing approximately 36.7 gm, were identified.

Although complicated by the fact that at least two individuals are represented, the relatively larger size of these fragments compared to the first example, prompted one of us (RIQ), with the assistance of Michele Douglas, to reconstruct the missing shafts of the long limb bones of both burials. This reconstruction effort resulted in the almost complete restoration of two pairs of femora, one pair of tibiae, and the partial shafts of one pair of tibiae and one pair of fibulae (Fig. 4 and 5). The remaining fragments that could not be conjoined appear to represent the unre-

Figure 4. Diagram showing the reconstructed leg bones of Burial # 1 (present study), a 40–45 year old male. The lower limb bones of this individual were found to have been shattered into many fragments. In the laboratory, it was possible to reconstruct almost complete shafts of these bones from the fragments found with this burial. The blackened areas represent parts of the bones still missing. It is very possible that some of the remaining small fragments may account for these missing areas.


RIGHT FEMUR
anterior view
posterior view
LEFT FEMUR
anterior view
posterior view
RIGHT TIBIA
anterior view
posterior view
LEFT TIBIA
anterior view
posterior view
RIGHT FIBULA
anterior view
posterior view
LEFT FIBULA
anterior view
posterior view

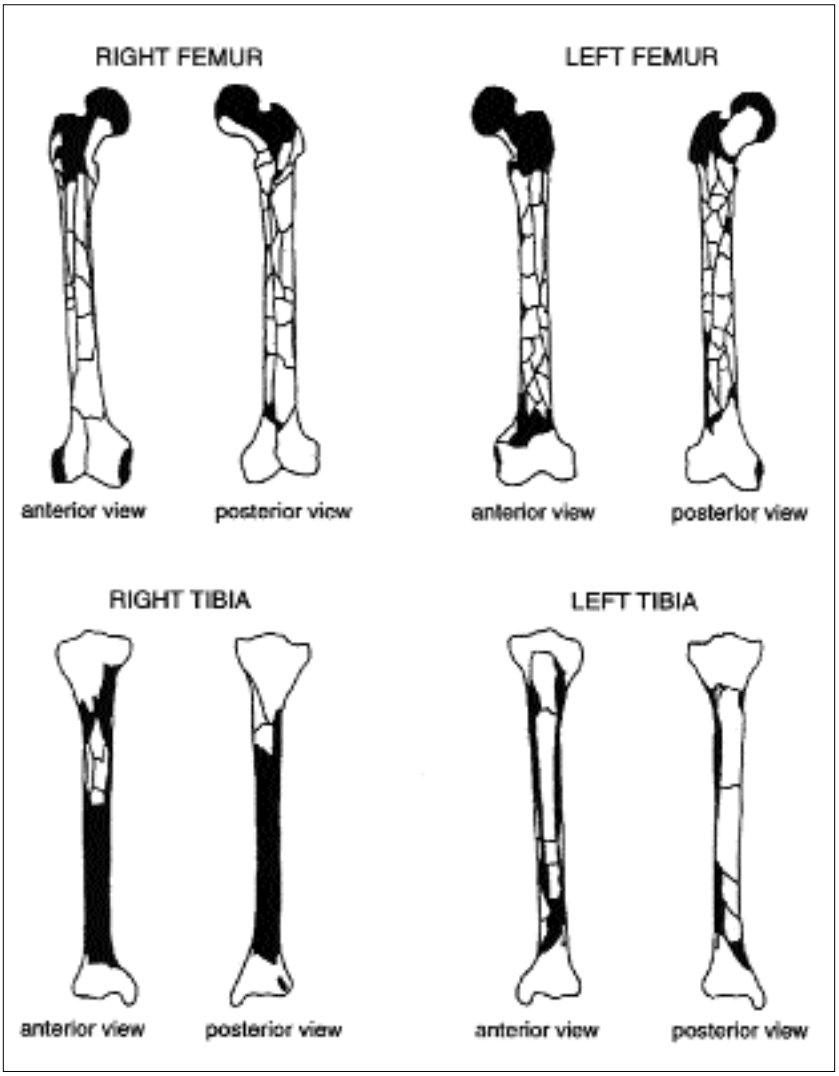


Figure 5. Diagram showing the reconstructed femora and tibiae of Burial # 2, a 50–55 year old male, whose fragmented remains were found in the same archaeological feature as Burial #1. The majority of the shafts of these four bones could be restored from the fragments associated with this burial.

stored areas of the remaining leg bones. Most of the arm bones and one pair of fibulae are either missing or could not be identified in these remains.

Closer inspection of the reconstructed shafts indicates the presence of several impact sites along the long bone shafts of the femora and one pair of tibiae. Each impact site is less than 5 cm in length. No clear pattern of the location of the impact sites on the femora is discernible. Two tibiae, however, have distinct impact sites located on the anterior midshafts of these bones. The morphology of several of the impacted areas suggests that the object used to deliver the blow had a thin, sharp edge, such as found in a basalt flake or a chopper-like stone tool. The presence of distinct impact sites indicate that sudden, concentrated blows were employed to fracture the bone rather than a distributed, constant pressure, such as crushing in a vise.

Two additional burials from the same project area exhibit post-interment removal of the long limb bones. In these instances, the long limb bones of the legs (femora, tibiae, fibulae) were missing. The skeletons were completely articulated except for the missing bones. The bones of the ankle and feet were in their original interment positions, confirming that the bones had been removed after the individuals had been placed in their respective graves. Although direct evidence is lacking, the missing bones may have been culturally modified elsewhere and never returned to the graves from which they were taken, or they may have been re-interred elsewhere. A further possibility is that they were retained as keepsakes or for some other purpose.

Review of Hawaiian Osteology Studies

In an attempt to document the extent and prevalence of intentional bone fragmentation in Hawaiian skeletal remains, a review of the published and unpublished osteological reports was undertaken. Eight historic, two late prehistoric/early historic, and twelve prehistoric skeletal series, from the islands of O‘ahu, Maui, Kaua‘i, and Hawai‘i, were investigated. A list of the series examined is given in Table 1.

Examples of intentional bone fragmentation that meet the definition of bone modification described in the present study, are identified in five skeletal series (Table 2). More detailed descriptions of individual cases of bone alteration for each of these series are given in Table 3. Although some of the series may contain late prehistoric and early contact skeletal remains, the series with examples of bone alteration represent essentially prehistoric coastal sand dune cemetery sites. Two of the sites are located in

Table 1. Hawaiian Skeletal Series Surveyed in Present Study

Skeletal Series	Location	Size	Dates	Reference
Historic				
Kakaʻako	Oʻahu	28	1853–1854	Pietrusewsky et al., 1989a
Mākaha	Oʻahu	≥3	historic	Pietrusewsky, 1972
Marin Tower	Oʻahu	15	ca1810– ca1850	Goodwin et al., 1992; Pietrusewsky et al., 1993
Waiʻanae	Oʻahu	5	1865–1900	Pietrusewsky and Douglas, 1990a
ʻAuhaukeaʻē	Hawaiʻi	24	1890–1906	Pietrusewsky and Douglas, 1989b
Kailua-Kona	Hawaiʻi	3	historic	Pietrusewsky and Douglas, 1990b
Keōpū	Hawaiʻi	13	1840–1930	Collins, 1986
Kahoma	Maui	23	post-late 1800s?	Pietrusewsky et al., 1989b
Historic/Prehistoric				
ʻAnaehoʻomalu	Hawaiʻi	100	prehistoric/historic	Pietrusewsky, 1971; Pietrusewsky et al., 1990
Kukailimoku	Hawaiʻi	41	?	Trembly, 1984
Prehistoric				
Bellows	Oʻahu	5	prehistoric	Pearson et al., 1971
Kualoa	Oʻahu	42	AD. 1400–1600	Pietrusewsky and Douglas, 1989a
Mōkapu	Oʻahu	1171	prehistoric	Bowen, 1961, 1974; Snow, 1974; Collins et al., 1994
Waiʻanae	Oʻahu	14	prehistoric	Pietrusewsky and Douglas, 1990a
Kalāhuipuaʻa	Hawaiʻi	30	prehistoric	Kam, 1979
Keōpū	Hawaiʻi	342	AD. 1330–1780	Collins, 1986
Puʻuhonua o Hōnaunau	Hawaiʻi	145	prehistoric?	Soehren and Tuohy, 1987; Tuohy et al., 1987
South Point	Hawaiʻi	≥97	AD. 1600–1780	Underwood, 1969
Honokahua	Maui	712	AD. 610–1800	Pietrusewsky et al., 1991
Hāʻena	Kauaʻi	31	prehistoric	Pietrusewsky et al., 1992
Kapaʻa	Kauaʻi	29	prehistoric?	Pietrusewsky et al., 1994
Keoneloa	Kauaʻi	38	prehistoric	Douglas and Ikehara, 1991

the northeastern coast of Oʻahu (Kualoa and Mōkapu), two are from the southwestern coast of Hawaiʻi (Keōpū and Hōnaunau), and one is from Maui (Honokahua). Although probably a reflection of the availability of extensive skeletal series for these islands, no cases of grave vandalism involving the deliberate smashing of human bone were identified in the remains from Kauaʻi, Lānaʻi, or Molokaʻi. The greatest number of examples of deliberate alteration of human bone is that reported for Keōpū, where 31 of the 342 prehistoric burials exhibit intentional bone fragmentation (Collins 1986). Twenty-four cases (details for eleven of which are presented in Table 3) of human bone alteration have been reported from Mōkapu. However, when sample size is taken into consideration, the highest frequency of intentional bone fragmentation occurs in the present study where three of the 27 burials, or 11.1%, exhibit evidence of bone alteration. The skeletal series with the next highest frequencies include Kualoa (4/42, or 9.5%) and Keōpū (31/342, or 9.1%), respectively.

With the exception of the Keōpū series, intentional bone fragmentation occurs more often in male skeletal remains than in female remains. In the present

Table 2. Hawaiian Skeletal Series with Intentional Bone Fragmentation

Site	No. of Cases	No. of Adults ♂	No. of Adults ♀	No. of Adults ?	Sample Size	Comments	References
Present study	3	3			27		
Kualoa, Oʻahu	4	3	1		42		Pietrusewsky and Douglas, 1989a
Mōkapu, Oʻahu	24	18	2	3	1544	Summary information for Mōkapu is taken largely from Collins et al. (1994), who do not provide individual descriptions of the 24 cases. Eleven cases, originally identified in Snow (1974) and Bowen (1974) are presented in Table 3.	Bowen,1961, Snow 1974; 1974; Collins et al., 1994
Keōpū, Hawaiʻi	31	13	14	4	342	Cases of cut shaft bone are described in prehistoric specimens only.	Collins, 1986, pers. comm. 1994
Puʻuhonua o Hōnaunau, Hawaiʻi	1			1	145		Tuohy et al., 1987
Honokahua, Maui	8	6	2		712	One of these burials had intact ends of the femora and tibiae but no shaft fragments; another burial (not included here) with missing long limb bones is possibly associated with two long limb bone fragments which have "chevron-like grooves cut into them . . . dense bone . . . cut to resemble a spear point."	Pietrusewsky et al., 1991; original burial records

study, all three cases involve the skeletal remains of males. Three times as many males as females exhibit bone fragmentation in both the Kualoa and Honokahua series. An even greater sex difference is observed in the Mōkapu series where 18 males and two females are affected. Only in the Keōpū series is the sex ratio about equal. None of the remains involve subadults.

Discussion

A review of the early ethnohistorical and some of the more recent archaeological literature indicates several different explanations to account for the type of cultural modification of bone discussed in this paper.

Bone As Material for Artifacts

The most popular and the most frequently cited reason for the alteration and removal of human bone from Hawaiian skeletal series centers on bone as material for the manufacture of fishhooks, arrows, awls or needles, and other kinds of tools. Malo, for example, states:

> The fish-hooks of the Hawaiians were made of human bones, tortoise shell and the bones of pigs and dogs (1951:79).

Emory, Bonk and Sinoto (1959:21) indicate that human bone was one of the most popular materials for making fishhooks. Similarly, Kirch, when discussing the manufacture of fishhooks at South Point on the island of Hawaiʻi, writes:

Table 3. Summary of Cultural Alteration of Human Bone in Hawaiian Skeletal Series

Burial Number, Sex, Age (in Years)	Type of Alteration	MNI[1] Within Debitage	Long Limb Bones Fragmented	Comments	References
PRESENT STUDY					
Burial 1, male, 40–45; Burial 2, male, 50–55	fragmentation (shattering) of shafts with ends intact	2	Two R femora, two L femora, two R tibiae, two L tibiae, and one pair of fibulae identified	Burials 1 and 2 were sorted from two bone concentrations found within a single burial feature; the bones were reconstructed.	Present study
Burial 3, male, 45–50	fragmentation (shattering) of shafts with ends intact	1	humeral and femoral fragments identified	These fragmented bones were not reconstructed.	
KUALOA					
#6, male, young adult	fragmentation of shafts with ends intact	1	humeri?, fibulae?		Pietrusewsky and Douglas, 1989a
#6A, male, middle-aged	fragmentation of shafts with ends intact	1	unidentified shaft fragments	Additionally, cut marks on proximal tibial epiphysis and proximal femoral shaft fragment.	
#7, male, adult	fragmentation of shafts with ends intact	1	femur?, humerus?, tibia?	Additionally, six epiphyseal fragments exhibit cut marks; associated with nine basalt flakes and an *'ulu maika.*	
#12, female, adult	fragmentation of shafts with ends intact	1	unidentified shaft fragments	Associated with a sharpened basalt flake.	
KEŌPŪ					
TP5-1A, male, 25–30; TP5-1B, ?female, adult	cut bone fragments	2	radial, femoral, tibial, and fibular shafts	Burials TP5-1A and TP5-1B were found in the same burial pit.	Collins, 1986; pers. comm.
TP5-2A, ?female, adult	cut bone fragments	1	R & L humeri, L radius, R ulna, & L tibia shaft fragments	"shaft fragments . . . vandalized prehistorically."	
TP5-4, female, 50–55	cut bone fragments	1	L humeral shaft	"cut L humeral shaft"; "defleshing cut marks on L & R femora, & L tibia."	
TP5-5, female, 30–35	cut bone fragment	1	fibular shaft	Fibular fragment is debitage but R & L femora, tibiae, & R humerus are missing.	
G25-2, female, adult	cut bone fragments	1	all long limb bones		
G26-1, female, adult	cut bone fragments	1	all long limb bones		
H21-1, ?sex, adult	cut bone fragments	1	femur?	only L femur and patellae present.	
H21-2, male, 35–40	cut bone fragments	1	R femur, tibiae		
H21-3, female, 50–55	cut bone fragments	1	R fibula, tibiae		
H21-5, female, 55+	cut bone fragments	1	tibiae, fibulae		
H25-1, ?male, adult	cut bone fragments	1	femora, tibiae, fibulae, humeral(?) shaft fragments		

Continued on next page

Table 3. Summary of Cultural Alteration of Human Bone in Hawaiian Skeletal Series (continued)

Burial Number, Sex, Age (in Years)	Type of Alteration	MNI[1] Within Debitage	Long Limb Bones Fragmented	Comments	References
J19-5, male, adult	cut bone fragments	1	shafts of all long bones		
J21-3, female, 50–55	cut bone fragments	1	R femur and tibia		
J27-4, female, adult	cut bone fragments	1	humeral, radial, femoral, tibial, fibular shafts	recognizable fragments, but sides could not be determined.	Collins, 1986; pers. comm.
K18-2, male, old adult	cut bone fragments	1	L femur, tibiae		
K21-6, ?female, adult	cut bone fragments	1	shaft fragments of humeri, radii, ulnae, a femur, tibia & R fibula	secondary bundle burial.	
L18-3, male, old adult	cut bone fragments	1	all long bones except L radius		
L21-2, ?sex, adult	cut bone fragments	1	all long limb bones	?secondary bundle burial; side of	
L26-2B, ?sex, adult	cut bone fragments	1	humeri, femora, tibiae, & fibulae	humeral fragments could not be determined.	
M18-4, female, 25–30	cut bone fragments	1	all long limb bones were fragmented		
M20-1, male, 30–35	cut bone fragments	1	unidentified bone fragments	L scapula blade is cut; R & L humeri, femora, tibiae, & fibulae are missing.	
N19-7, male, old adult	cut bone fragments	1	humeri, femora, & tibiae		
N19-8, female, 55+	cut bone fragments	1	femora & tibiae		
N20-5, female, 25–30	cut bone fragments	1	L ulna & femur		
N20-6, ?male, adult	cut bone fragments	1	humeri, ulnae, radii, femora, tibiae; L fibula		
N20-8, ?male, adult	cut bone fragments	1	femora, tibiae, & fibulae		
N21-2, male, 30–35	cut bone fragments	1	humeri, ulnae, & radii		
?sex, ?adult	cut bone fragments	1	unidentified shaft fragments	"cut bone fragments in O18-1 [a 35–40 yr. old male 'disturbed prehistorically'] probably come from another individual."	Collins, 1986; pers. comm.
O21-8A, male, 50–55	cut bone fragments	1	humeri, L radius, ulna, femora, tibiae, & fibulae		
O21-8B, male, adult	cut bone fragments	1	L humerus, radius & ulna; R & L femora, tibiae, & fibulae		
MŌKAPU[2]					
C-23A, male, 25	"splintered shafts" with ends intact	1	unidentified shaft fragments	Femoral heads have cut marks.	Bowen, 1961, 1974; Snow, 1974
C-43, male, adult	fragmentation of shafts with ends intact	1	all long limb bone shafts	Associated with a basalt cutting tool.	

Continued on next page

Table 3. Summary of Cultural Alteration of Human Bone in Hawaiian Skeletal Series (continued)

Burial Number, Sex, Age (in Years)	Type of Alteration	MNI[1] Within Debitage	Long Limb Bones Fragmented	Comments	References
CX-12, male, adult	cut marks on femoral necks; femoral and tibial shafts missing	1	no shafts recovered	Present: "ends of femur and tibia with cut marks on femoral heads."	
HX, male, adult	intact ends of long limb bones with shafts missing.	1	no shafts recovered	Present: "ends of limb bones."	
N-3, male, young adult	cut marks on ends of femur and tibia, shafts missing	1	no shafts recovered	Present: "ends of both femur and tibia with cut marks."	Bowen, 1961, 1974; Snow, 1974
H-196, male, 35	head of right tibia intact; rest of long limb bones missing	1	no shafts recovered	Present: "head of right tibia, skull, four vertebrae (cervical, thoracic, and lumbar)"; questionable case.	
H-218, male, 35	cut marks on tibia and femur, shafts missing	1	no shafts recovered	Present: "large ends of all long bones . . . with cut marks on tibia and femur; pelvis."	
CX-13, female, adult	femoral ends intact with shafts missing	1	no shaft fragments	Present: "both femoral heads, pelvis, sacrum, vertebrae, ribs, and four long bones"; distal femoral ends also present.	
H-117, male, 35–40	femoral heads intact, with shafts and distal ends missing	1	no shafts recovered	Present: "both femoral heads, pelvis, sacrum, vertebrae, ribs, and four long bones."	
H-252, female, 22–24	"splintered shafts" with ends intact	1	unidentified shaft fragments		
N-6, male, adult	fragmentation of shafts with ends intact	1	humeri?, radii?, femora?	Associated with seven basalt flake tools.	
PU'UHONUA O HŌNAUNAU					
Q23/1 Burial 3, male	fragmentation of shafts	1	unidentified shaft fragments	Associated with worked (human?) bone fragments; Most bones of this burial are fragmented.	Tuohy et al., 1987
HONOKAHUA					
44, male, 40–50	fragmentation of shafts with ends intact	1	femora, tibiae, fibulae	The bone fragments were found in a pile along with a basalt flake cutting tool; the rest of the skeleton is missing.	Pietrusewsky et al., 1991; original burial records
80, male, 55+	fragmentation of shafts with ends intact	1	femora, tibiae, fibulae	Cut marks are visible on the distal end of the left radius and ulna; associated with basalt flakes and a hammerstone.	
130, female, 50+	fragmentation of shafts (most ends missing)	1	most long limb bone shafts?	Some cut marks are visible on the fragments; most other bones are fragmented and poorly preserved.	

Continued on next page

Table 3. Summary of Cultural Alteration of Human Bone in Hawaiian Skeletal Series (continued)

Burial Number, Sex, Age (in Years)	Type of Alteration	MNI[1] Within Debitage	Long Limb Bones Fragmented	Comments	References
162, male, 40–50	fragmentation of tibial shafts with ends intact	1	tibiae	Cut marks visible on distal femoral shafts (distal ends missing) and ends of tibiae. Some fragments have cut marks.	
258, male, 45–50	fragmentation of shafts with most ends intact	1	all long limb bones shafts?		
304, male, 50	fragmentation of shafts with most ends intact	1	all long limb bone shafts?		Pietrusewsky et al., 1991; original burial records
364, female, 40–50	ends of leg bones intact with shafts missing	1	no shaft fragments	Disturbance of entire torso; "cut ends of femurs and tibiae."	
610, male, 50+	fragmentation of shafts with intact ends	1	most long limb bones shafts?	Secondary burial; bones were jumbled together, fragmented and in very poor condition; some cut edges are visible on the shafts.	

[1] MNI = Minimum Number of Individuals
[2] Only 11 of the 24 cases identified in Collins et al. (1994) are identified here.

> The largest one-piece and two-piece hooks were made from human long bones . . . it was believed that the *mana* of the deceased would render the hook particularly efficacious (1985:204).

Buck is more specific on the subject when he states:

> Human long bones, particularly the thigh bone, were cut in lengths probably with sharp-edged pieces of stone flakes [for fishhooks] (1957: 324).

According to some earlier scholars, the practice of using human bone in the manufacture of fishhooks and other utilitarian objects was usually considered to be an insult and a way to humiliate enemies defeated in war. Kamakau, for example, states that bones were sometimes dug up for food and bait for sharks:

> During the time of wicked, traitorous, and desecrating chiefs, the bones of the dead were dug up out of the burial grounds to be used for arrows for rat shooting and for fishhooks, and the bones and bodies of the newly buried were dug up for food and bait for sharks (1964:38).

In a similar vein, Fornander writes:

> To turn bones into fishhooks or [use them] for other practical uses [arrowheads or needles] was the most dreaded insult (1916–20:212).

More recently, Kirch has stated that:

> The practice of making hooks from human bone was also used to humiliate enemies defeated in war (1985:204).

On the other hand, Buck notes that it was considered an honor to have one's bones used in a *kahili* handle (Buck 1957:579). The practice is confirmed by Pukui et al. who state:

> Bones, usually the leg bones, of a defeated enemy were sometimes put inside the supporting pole or standard of a *kahili* (1972:109).

Garland (1986:119,130) has suggested that human bone was used to manufacture fishing gear to account for the cut bone found in 35 individuals from Keōpū on the island of Hawai'i.

Keepsakes

Another cited reason for removing human bones from graves is given by Malo:

> Sometimes a person would secretly exhume the body of a beloved husband or wife and remove the four leg bones and the skull, washing them in water until they were clean. They were then wrapped up and enclosed within the pillow, and the friend took them to bed with him and slept with them every night . . . These parts of the corpse were preserved by the fond lover until such time as the love came to an end (1951:98–99).

However, the removal of bones as keepsakes does not seem to apply in the present case since the bones had been deliberately smashed and fragmented and then reburied (not removed) with the rest of the skeleton, not long after their initial disturbance.

Cannibalism

Although documented cases of it are rare in Hawai'i (see Valeri 1985:403), cannibalism, especially starvation-induced, or "survival" cannibalism (White 1992), cannot be ruled out as a possible cause of the bone alteration seen in Hawaiian remains. Certainly, a case could be made that some of the key elements in the archaeological recognition of cannibalism, e.g., percussion damage, fracture, and similar patterns of long bone breakage that might facilitate marrow extraction (Villa et al., 1986, White 1992), are observed in the present cases. Possible archaeological evidence for cannibalism has been presented for several other Polynesian and Pacific Islands including New Zealand (Davidson 1979a), Samoa (Davidson 1979b), Marquesas (Sinoto, 1979), and Fiji (Gifford 1951, Best 1984).

The re-interment of the broken bone fragments with the original burial and the time interval when these events occurred, would appear to weaken the argument that the examples of prehistoric vandalism presented here are examples of cannibalism. Further, since the bone alteration seems to have occurred when there was little or no flesh on these remains, the presence of bone marrow was probably equally non-existent, thus making them a less than attractive source of nourishment.

Other

Other explanations to account for the deliberate destruction of bones, including wanton desecration, or prehistoric vandalism, and/or the possibility of releasing a dead individual's *mana* may warrant further attention. The argument for desecration, however, is weakened by the observation that the vandalized remains were then re-interred in what can be regarded as a respectful manner. Further, if bones were being systematically shattered to release the *mana* they contained, then this practice, given its low frequency, would not appear to have been very widespread in ancient Hawai'i. Additional information concerning the archaeological context of the cases described, which unfortunately was not possible in the present study given the sensitivity of doing archaeological research in Hawai'i, would obviously have provided further insights into interpreting this behavioral pattern.

Conclusions

Although previous researchers have reported instances of intentional bone fragmentation in prehistoric skeletal remains from Hawai'i, these reports often do not provide sufficient detail to assess this cultural practice fully. The present study, which provides a relatively detailed qualitative and quantitative description of three recent cases of intentional bone fragmentation observed in Hawaiian skeletal remains from the island of O'ahu, will hopefully provide a basis for future research in this area. This study, which includes the restoration of some of the fragmented long limb bones, indicates that few, if any, of the smashed and shattered fragments of the long limb bones are actually missing in these secondary deposits. The additional finding of percussion damage, further suggests that the bones were being smashed and pounded by a hammerstone-like object, probably with a sharp-edge, rather than being cut. The fragmentation occurred perimortem, or around the time of death, and most likely when there was little flesh adhering to the bone. Unaccounted for, in at least two of the examples discussed, is the whereabouts of several missing, and presumably likewise fragmented, arm bones and one pair of fibulae.

A survey of the osteological literature indicates at least five other sites from Hawai'i that provide examples of bone alteration similar to those reported in this study. All of the examples involve coastal sand dune burial sites believed to contain prehistoric human remains of commoners. Some of the highest frequencies of bone fragmentation are those reported for the present series (from O'ahu), and in the Keōpū (Hawai'i), and Kualoa (O'ahu) skeletal series.

The most frequently cited explanation of bone fragmentation in prehistoric Hawaiian skeletal remains is the use of human bone as material for the manufacture of fishhooks and other kinds of tools. The present study, which has demonstrated that little or no bone was removed from the grave site, only weakly supports this interpretation. Further work, like that begun here, is needed to better assess the alternative explanations. Unfortunately, given the current political climate which does not allow research involving human skeletal remains from Hawai'i, we may never be able to explain this cultural practice fully.

Acknowledgments

We should like to thank Michele Douglas for her assistance in reconstructing the shattered limb bones examined in this paper and for her comments and suggestions on several previous drafts of this paper. An earlier version of the paper was presented at the 7th Annual Hawaiian Archaeology Conference, University of Hawai'i at Hilo, April 1–3, 1994. Due to the sensitive nature of studying human remains from Hawai'i, the identity of the site where the remains described in this paper were found, is being withheld.

References

Best, S. B. 1984. Lakeba: The prehistory of a Fijian Island. Ph.D. thesis, University of Auckland, Auckland.

Bowen, R. 1961. Hawaiian disposal of the dead. M.A. thesis, University of Hawai'i, Honolulu.

———. 1974. Mōkapu: Its historical and archaeological past. In *Early Hawaiians: An initial study of human remains from Mōkapu, Oahu,* by C. E. Snow, 129–148. Lexington, KY: University Press of Kentucky.

Buck, P. H. 1957. *Arts and Crafts of Hawai'i.* B. P. Bishop Museum Special Publication 45. Honolulu: Bishop Museum Press.

Cleghorn, J.N.J. 1987. Hawaiian burial reconsidered: An archaeological analysis. M.A. thesis, University of Hawai'i, Honolulu.

Collins, S. L. 1986. Osteological studies of human skeletal remains from the Keōpū burial site. In *Moe kau a ho'oilo. Hawaiian mortuary practices at Keōpū, Kona, Hawai'i,* by T. L. Han, S. L. Collins, S. D. Clark and A. Garland, 165–249, and Appendix D, 291–389. Departmental Report Series No. 86–1. Honolulu: Department of Anthropology, B. P. Bishop Museum.

———. 1994. Personal communication, March 18, 1994.

Collins, S. L., T. Han, and L. Armstrong. 1994. *Inventory of human skeletal remains from Mōkapu Peninsula, Ko'olau Poko District, Kāne'ohe and He'eia Ahupua'a, O'ahu Island.* Prepared for U. S. Navy Hawai'i. Honolulu: Department of Anthropology, B. P. Bishop Museum.

Davidson, J. M. 1979a. New Zealand. In *The prehistory of Polynesia,* ed. J. Jennings, 222–248. Cambridge, MA: Harvard University Press.

———. 1979b. Samoa and Tonga. In *The prehistory of Polynesia,* ed. J. Jennings, 82–109. Cambridge, MA: Harvard University Press.

Douglas, M. T. and R. M. Ikehara. 1991. *Human skeletal and dental remains recovered from the Keoneloa Bay Villa project area, Weliweli and Pā'ā Ahupua'a, South Kaua'i.* Prepared for Cultural Surveys Hawai'i. Kailua: Cultural Surveys Hawai'i.

Emory, K. P., W. J. Bonk, and Y. H. Sinoto. 1959. *Hawaiian Archaeology: Fishhooks.* Bernice P. Bishop Museum Special Publication 47. Honolulu: Bishop Museum Press.

Fornander, A. 1916–20. *Fornander collection of Hawaiian antiquities and folk-lore.* Ed. T. G. Thrum. B. P. Bishop Museum Memoirs 4, 5 & 6. Honolulu: Bishop Museum Press.

Garland, A. 1986. Artifacts and manuports from the Keōpū burial site. In *Moe kau a hoʻoilo. Hawaiian mortuary practices at Keōpū, Kona, Hawaiʻi,* by T. L. Han, S. L. Collins, S. Clark and A. Garland, 119–164. Departmental Report Series No. 86–1. Honolulu: Department of Anthropology, B. P. Bishop Museum.

Gifford, W. W. 1951. Archaeological excavations in Fiji. *University of California Anthropological Records* 13:3. Berkeley.

Goodwin, C., M. Pietrusewsky, M. T. Douglas, R. M. Ikehara. 1992. *The burials from the Marin Tower property: Preliminary report.* Prepared for International Archaeological Research Institute, Inc. Honolulu: International Archaeological Research Institute, Inc.

Kam, W. 1979. Osteological study of human skeletal remains at Kalāhuipuaʻa. In *Marine exploitation in prehistoric Hawaiʻi,* ed. P. V. Kirch, 211–228. Pacific Anthropological Records 29. Honolulu: Department of Anthropology, B. P. Bishop Museum.

Kamakau, S. 1964. *Ka poʻe kahiko: The people of old.* Trans. Mary Pukui. B. P. Bishop Museum Special Publication 51. Honolulu: Bishop Museum Press.

Kirch, P. V. 1985. *Feathered gods and fishhooks.* Honolulu: University of Hawaiʻi Press.

Malo, D. 1951. *Hawaiian antiquities.* 2d ed. Trans. N. B. Emerson. Bernice P. Bishop Museum Special Publication 2. Honolulu: Bishop Museum Press.

Pearson, R. J., P. V. Kirch, and M. Pietrusewsky. 1971. An early prehistoric site at Bellows Beach, Waimānalo, Oahu, Hawaiian Islands. *Archaeology and Physical Anthropology in Oceania* 6(3):204–234.

Pietrusewsky, M. 1971. *Human skeletal remains at ʻAnaehoʻomalu.* Departmental Report Series 71–7. Honolulu: Department of Anthropology, B. P. Bishop Museum.

———. 1972. Analysis of skeletal remains from Site C4-265, Mākaha Valley. In *Mākaha Valley historical project: Interim report no. 3,* ed. E. J. Ladd and D. E. Yen. Pacific Anthropological Records 18. Honolulu: Department of Anthropology, B. P. Bishop Museum.

Pietrusewsky, M. and M. T. Douglas. 1989a. *An osteological study of human remains recovered from Kualoa Regional Park, windward Oʻahu Island, Hawaiʻi.* Typescript on file, Department of Anthropology, University of Hawaiʻi., Honolulu.

———. 1989b. *An osteological study of late historic human remains recovered from ʻʻAuhaukeaʻē, North Kona, Hawaiʻi.* Prepared for Cultural Surveys Hawaiʻi. Kailua: Cultural Surveys Hawaiʻi.

———. 1990a. *An osteological study of human remains recovered in 1988–89 from Waiʻanae Army Recreation Center, Waiʻanae, Oʻahu, Hawaiʻi.* Typescript on file, Department of Anthropology, University of Hawaiʻi, Honolulu.

———. 1990b. *Three historic coffin burials from Site BPBM 50-Ha-D8-64, Kailua-Kona, North Kona, Hawaiʻi.* Honolulu: International Archaeological Research Institute, Inc.

Pietrusewsky, M., M. T. Douglas, and R. M. Ikehara. 1989. *An osteological study of human remains from the Kahoma Stream Flood Control Project, Lahaina, Maui.* Prepared for the U. S. Army Corps of Engineers. Honolulu: U.S. Army Corps of Engineers.

———. 1992. *Osteological analysis of human remains found at Site 50-30-03-1809 (TMK 5-9-02-31), Hāʻena, Haleleʻa, Kauaʻi (Anawalt Property).* Prepared for Anawalt Lumber Company, Los Angeles. Typescript on file, Department of Anthropology, University of Hawaiʻi, Honolulu.

———. 1993. *An osteological investigation of the historic burials from the Marin Tower housing project, Honolulu, Hawaiʻi.* Honolulu: International Archaeological Research Institute, Inc.

Pietrusewsky, M., M. T. Douglas and P. A. Kalima. 1990. *Human skeletal remains recovered from ʻAnaehoʻomalu, South Kohala, Hawaiʻi Island: A second study.* Hilo: Paul H. Rosendahl, Ph.D., Inc.

Pietrusewsky, M., M. T. Douglas, P. A. Kalima, and R. M. Ikehara. 1991. *Human skeletal and dental remains from the Honokahua burial site, Land of*

Honokahua, Lahaina District, Island of Maui, Hawai'i. Hilo: Paul H. Rosendahl, Ph.D.

Pietrusewsky, M., R. Ikehara-Quebral, and M. T. Douglas. 1993. *Human skeletal remains from the Kapa'a Sewer Line Project, Wailua, Olohena, Waipouli and Kapa'a, Kaua'i.* Kailua: Cultural Surveys Hawai'i.

Pukui, M. K., E. W. Haertig, and C. A. Lee. 1972. *Nana i ke kumu (Look to the source).* Vol. I. Honolulu: Hui Hanai.

Sinoto, Y. H. 1979. The Marquesas. In *The prehistory of Polynesia,* ed. J. Jennings, 110–134. Cambridge: Harvard University Press.

Snow, C. E. 1974. *Early Hawaiians. An initial study of skeletal remains from Mōkapu, Oahu.* Lexington, KY: University of Kentucky Press.

Soehren, L. J. and D. P. Tuohy. 1987. *Archaeological excavations at Pu'uhonua o Hōnaunau National Historical Park, Hōnaunau, Kona, Hawai'i.* Departmental Report Series 87-2. Honolulu: Department of Anthropology, B. P. Bishop Museum.

Trembly, D. 1984. *Analysis of human skeletal material from Kukailimoku Beach, Hawai'i.* Hilo: Paul H. Rosendahl, Ph.D., Inc.

Tuohy, D. R., A. K. Inouye, F. O. Sato, W. Tachibana, and M. G. Tanaka. 1987. List of human interments. In *Archaeological excavations at Pu'uhonua o Hōnaunau National Historical Park, Hōnaunau, Kona, Hawai'i,* ed. L. J. Soehren and D. P. Tuohy, 225–262. Departmental Report Series 87-2. Honolulu: Department of Anthropology, B. P. Bishop Museum.

Underwood, J. 1969. *Human skeletal remains from Sand Dune Site (H1), South Point (Ka Lae), Hawaii.* Pacific Anthropological Records 9. Honolulu: Department of Anthropology, B. P. Bishop Museum.

Valeri, V. 1985. *Kingship and sacrifice: Ritual and society in ancient Hawaii.* Chicago: University of Chicago Press.

Villa, P., C. Bouville, J. Courtin, D. Helmer, E. Mahieu, P. Shipman, G. Belluomini, and M. Branca. 1986. Cannibalism in the Neolithic. *Science* 233: 431–436.

White, T. D. 1992. *Prehistoric cannibalism at Mancos 5MTUMR-2346.* Princeton: Princeton University Press.

From Whence Came Tuberculosis to Hawai'i?

Diane Trembly

Kea'au, Hawai'i

Although tuberculosis is primarily a disease of the lungs, it can spread to other organs, especially bone, by direct extension or through the blood. The onset is most often in childhood or adolescence. The most common site for skeletal tuberculosis is the thoraco-lumbar portion of the vertebral column, followed by the hip and the knee. The lesions are destructive, producing loculated cavities, with little or no reactive bone.

In the vertebrae the centra may be totally destroyed, although the transverse and posterior processes are rarely affected. Contiguous vertebrae are usually affected. When contiguous centra are destroyed, while the posterior processes are intact, the result is collapse of the anterior part of the segment of the vertebral column, so that the spine folds over on itself, producing an acutely angled bend of ninety degrees or more. The involved vertebrae fuse together, and the entire mass is called a gibbus and is virtually pathognomic for tuberculosis. While vertebral centra may collapse as a result of osteoporosis, the bend (or kyphosis) produced is not as acute as that of a gibbus. Compression fractures result in wedge-shaped centra, but usually involve only one vertebra, and do not result in any marked kyphosis. There are other infectious agents that can produce destructive lesions of vertebrae, and early or mild tuberculosis before gibbus formation may be difficult to distinguish from them; the gibbus makes the diagnosis clear.

Tuberculosis is an ancient disease, and has been found in the skeletons and mummies of Egypt dating from 3700 B.C., and in European skeletal remains dating as far back as 5000 B.C. (Merbs 1992; Ortner & Putschar 1981; Steinbock 1976). Pietrusewsky (1974) reported on a probable case of tuberculosis among remains from Non Nok Tha in northeastern Thailand. The affected remains were derived

from the last level of the Middle Period, which correlates to the end of the first millennium B.C. or beginning of the first millennium A.D. (Bayard 1968; Solheim et al. 1966). Both the verbal description and the photographs of the case from Non Nok Tha leave little doubt that the infectious agent was spinal tuberculosis—a classic gibbus is apparent at the level of the third through ninth thoracic vertebrae.

Evidence of Tuberculosis in Hawai'i

O'ahu

In 1974, Johnson and Kerley reported on two cases of vertebral lesions in the skeletal collection representing at least 1,171 individuals from Mōkapu, O'ahu, curated at the Bishop Museum. Johnson and Kerley (1974) considered these cases to be possible tuberculosis, and they provided descriptions and photographs. The photographs show vertebrae with large areas of destruction in the centra, but no collapse and no gibbus formation. Virtually identical lesions were found by Trembly and Hummert (1990) in the vertebrae of one of 21 individuals disinterred from a West Beach, O'ahu location.

Maui

Pietrusewsky et al. (1991) differentially diagnosed bony pathology in the skeletal remains of 22 individuals disinterred from a large burial site (over 700 individuals) at Honokahua, Maui as tuberculosis. The spines of five individuals show classic gibbus deformities. Of the five, two died in childhood, one in adolescence, and two lived into adulthood. There can be little doubt that these five individuals suffered from tuberculosis, whether or not the 12 other individuals reported as having vertebral lesions did, as discussed below. Another four individuals from Honokahua exhibited rib lesions of the type found by Kelley and Micozzi (1984) to be present in individuals known to have died of tuberculosis. There is also one individual from Honokahua with severe, bony destruction of the knee (at the greater trochanter of the femur). Upon viewing photographs of this case, Drs. Donald Ortner and Bruce Ragsdale suggested tuberculosis as the most likely diagnosis (pers. com.).

Twelve of the cases with vertebral pathology reported from Honokahua are not, however, diagnostic of tuberculosis. The presence of severe bony destruction without vertebral collapse is more characteristic of brucellosis, a disease transmitted by animals—usually pigs or cattle—to humans. Brucellosis has been present in Hawai'i since before epidemiological records were ever kept. Former Director of Health, Dr. John Lewin (pers. com.) speculated that brucellosis could have been introduced to Hawai'i with the European domestic animals left by Vancouver. If that is a possibility, then it is also possible that it was present before contact, brought in with the Polynesian Pig.

Hummert and Trembly (Hummert, in prep.) examined the skeletal remains of over 200 individuals from Wailea, Maui among whom were five individuals with evidence of tubercular lesions. Two of these individuals had the very characteristic lesions of vertebrae: one of the two also exhibited destructive changes in two ribs while in the other individual, the infection had spread from the lumbar vertebrae to the right pubis. In the other three cases, no affected vertebrae were present, however, the pathology present is very compatible with a diagnosis of tuberculosis, which is strengthened by the presence of the aforementioned two individuals in the same community. Of these three remaining cases from Wailea, one was a child with severe loculated destruction of the left knee joint (the distal femoral and proximal tibial epiphyses). All bones of the left leg and foot were smaller than those of the right side, which, by itself, would suggest paralysis of the left leg. However, given the pathology of the knee, it is most likely a case of underdevelopment due to lack of use from pain in the knee joint. In a second case, the site of infection was the wrist; the distal radius and ulna, carpal and metacarpal bones were affected. In the third individual, the site of infection was the left hip joint, with marked bony destruction of the femoral head and neck, and the acetabulum.

According to Steinbock (1974), five to seven percent of cases of pulmonary tuberculosis spread to bone. By these figures, if only the five individuals with a gibbus spine, and the one with knee disease at Honokahua represent tuberculosis, one may estimate that 100 of a population of 712 individuals had

tuberculosis. If those cases with rib lesions and/or those with non-diagnostic vertebral lesions also represent tuberculosis infections, then the total number of affected people is even higher. Using a similar statistic, approximately half the Wailea population examined would have suffered from tuberculosis. For various reasons, this statistic should only be applied cautiously to the populations with which we have dealt.

Summary of Hawaiian Evidence

Clearly, the skeletal evidence for the presence of tuberculosis in Hawai'i—at least on Maui—before European contact is irrefutable. Proto-historic accounts do not list "consumption" among the maladies observed, however, Howe (1984) quotes Parsonson as saying, "Cook's sailors at Hawai'i saw 'more deformed people than in all the other islands put together; some had prominences before and behind, or what we would call humped back.'" These may have been people with vertebral tuberculosis. While in skeletal remains gibbus deformity of the spine can be readily distinguished from the osteoporotic collapse of old age or idiopathic scoliosis, in the living, these conditions can be easily confused.

The Mōkapu burials from O'ahu are largely undated, however, a radiocarbon determination on wood charcoal obtained by Bowen (1974) yielded a date of 545 years B.P. Circumstantial evidence places the vast majority of the Mōkapu burials in the pre-contact era. As early historic accounts show, the Hawaiians sought metal implements, clothing, and articles of personal adornment from the moment of first contact (Daws 1968; Beaglehole 1966; Howe 1984). Post-contact burials reflect this in the nature of the accompanying artifacts and grave goods: buttons, beads, shoe and coffin nails are commonly found as are bottles and western implements (Bowen 1974; Trembly 1984, 1993; Pietrusewsky et al. 1990). None of these items accompanied the Mōkapu burials from the He'eia and Heleloa burial areas (Bowen 1974; Snow 1974). Neither were any such artifacts found at the Honokahua burial site, which, furthermore, has radiocarbon and volcanic glass dates from A.D. 610 to A.D. 1800 on wood charcoal and igneous materials directly associated with burials (Donham 1989).

Hypotheses of Origin and Transmission

The tuberculosis bacillus cannot be transported by wind currents, water, birds, or aquatic life. While it can be carried by cattle, we know there were no cattle in pre-contact Hawai'i. Therefore, tuberculosis had to be introduced by humans to pre-contact Hawai'i. The question then becomes: who introduced tuberculosis to Hawai'i in pre-Contact times, and when? Three alternative hypotheses, together with supporting and contradictory evidence are discussed below:

(1) Tuberculosis arrived with the first Polynesian settlers.

(2) Spanish explorers or merchant galleons brought tuberculosis to Hawai'i in the 16th or 17th centuries A.D. A variant of this hypothesis proposes that Quiros brought tuberculosis to the Marquesas Islands in 1595, and the bacillus traveled from there to Hawai'i via Hawaiian and/or Marquesan voyaging.

(3) Tuberculosis arrived in Hawai'i in pre-contact times through direct contact with native peoples of North or South America.

Tuberculosis Brought by the First Polynesian Settlers

Linguistic and archaeological evidence have firmly established that the Hawaiian people came from eastern Polynesia, probably the Marquesas and/or the Society Islands, in the early to middle first millennium A.D. The people of these eastern Polynesian islands, in turn, came from western Polynesia at least 2000 years ago. Furthermore, biological and archaeological evidence indicates that the people of the Lapita culture, whose recorded sites extend from at least the Bismarck Archipelago and northeast coast of Papua New Guinea to Tonga and Samoa, were the direct ancestors of the Polynesian peoples (Bellwood 1979a, 1979b; Green 1979; Kirch & Hunt 1988; Kirch 1988). The Lapita Culture flourished from c. 1800 B.C. until well into the first millennium B.C. (Kirch & Hunt 1988). Whether the Lapita Culture developed *in situ,* among people already living in near Oceania, or was brought by immigrants

from elsewhere, such as Southeast Asia, is debatable (Kirch 1988; Spriggs 1988). Clearly, however, if the tuberculosis bacillus came to Hawai'i with the original Polynesian settlers, then it must be traced back to the Lapita ancestors of the Polynesians and wherever they, or their ancestors, came from.

Available evidence suggests that the Lapita people were Austronesian speakers. The probable homeland of Proto-Austronesian may have been Taiwan or the Philippines, and the Oceanic branch may have reached the Lapita area in near Oceania (Papua New Guinea and the Bismarcks) via Sulawesi and the northwest coast of Papua New Guinea (Pawley & Green 1985; Tryon 1985). Tryon (1985) estimates that the Oceanic branch of Proto-Austronesian arrived in Papua New Guinea by 3500 B.C. Several theories attempt to explain the origin of the Lapita Culture: it was developed by populations living in near Oceania; the ancestral Lapita people arrived in near Oceania earlier or later than 3500 B.C.; the Lapita Culture was developed by populations in Taiwan and the Philippines or elsewhere and brought into near Oceania. Given these different views, if the tuberculosis bacillus that eventually found its way to Hawai'i accompanied the ancestral Lapita population, then it might have originated as early as 3500 B.C. in Taiwan, the Philippines or the Southeast Asian mainland. If migration into the near Oceanic Lapita homeland continued over time, then the bacillus may have originated perhaps as late as 1500 B.C.

If this is the route by which tuberculosis entered Hawai'i, then there should be a trail of evidence across the Pacific Ocean. The trail is a faint one, however, with very little evidence, either positive or negative. The majority of data on biological distances between and among Pacific populations have been taken from studies of cranial and dental remains, with some evidence obtained from examinations of the living (Howells 1973, 1979; Pietrusewsky 1970, 1977; Houghton 1980). Cranial and dental remains rarely if ever, however, show evidence of tuberculosis infection. Of the estimated 15,000 sets of Melanesian, Australian, and Southeast Asian remains thought to be curated by the world's museums, virtually all consist of cranial, mandibular, and/or dental remains only (Pietrusewsky, pers. comm. 1983).

Pietrusewsky examined the remains of 42 pre-contact individuals disinterred from the Hane Dune site at Ua Huka, Marquesas, and reported two possible cases of tuberculosis among them (Pietrusewsky 1976). The description and photographs, however, indicate that the described pathology is probably degenerative osteoarthritis in both cases, with a possible congenital fusion of vertebrae in one case. Neither the type of pathology nor the skeletal sites affected suggest tuberculosis. Marquesan skeletal remains representing some 120 individuals—including post-cranial bones—are curated at the American Museum of Natural History in New York, but no study or report of the palaeopathology has been conducted (Pietrusewsky, pers. com. 1983).

Douglas Owsley, George Gill and S. Ousley (1994) examined 500 skeletons from Rapanui or Easter Island; some remains were probably pre-contact while others were thought to be post-contact in age. The authors state that tuberculosis was a late, post-contact introduction, brought back by returning islanders who survived Peruvian enslavement (Owsley et al. 1994). Others who have examined Rapanui skeletal remains have seen no lesions suggestive of tuberculosis in pre-contact burials (Houghton, pers. comm.).

Efforts to obtain additional evidence, either positive or negative, from colleagues in the Pacific have not met with success. This probably reflects the lack of skeletal remains available for such examinations. Although tangential to the question of tuberculosis in Polynesia, it may be significant that in over 700 sets of Micronesian remains examined by the author, there was no pathology suggestive of tuberculosis. If the ancestors of the Polynesians brought tuberculosis with them from the Asian mainland, one might expect to find the disease in Micronesia also.

In short, there is no evidence of a "trail of tuberculosis" across the Pacific, but the amount of skeletal remains available for examination is not sufficient to be able to say the disease was not present.

Tuberculosis Brought by the Spanish

Fornander (1878–85) favored the view that the Spanish had made landfall in Hawai'i. He based this opinion on a Hawaiian tradition of castaways, and

the belief that two of Saavedra's ships were wrecked near the Hawaiian Islands in 1528. John Stokes (1932), however, quoting Dahlgren (1917), states that Saavedra was, in fact, 200 miles from Hawai'i at the time the two ships were lost, and, furthermore, that the ships would have had to sail into the wind and current to reach Hawai'i. Regarding the tradition of castaways, Stokes (1932) states that there are a dozen legends of castaways with variations in time and place, and considers these legends unreliable. Even though Fornander was of the opinion that Spanish had landed in Hawai'i, he nevertheless admitted that, "No traces of Spanish influence can now be found in the religion, knowledge, customs, or arts of the Hawaiians." The fact that iron was known to Hawaiians (in fact, Cook found iron implements present) has been another argument favoring a pre-Cook Spanish landing. Iron could have reached Hawai'i in driftwood boards, however. The shape of the Hawaiian helmet has been said to be Spanish in origin, but it is not; Stokes (1932) claims that the helmet resembles Greek headgear. Finally, no Hawaiian words have been shown to be derived from or borrowed from Spanish (Stokes 1932).

One thing seems certain: if any Spaniards made landfall in Hawai'i, they did not return to Spain and report on the incident. In 1790, Spain sent a naval officer to investigate Hawai'i. The title of the officer's report was "The Sandwich Islands: A brief description of the archipelago discovered by Capt. Cook." The title seems to indicate that no earlier report of discovery or landfall exists (Stokes 1932).

Stokes (1932) comments that, considering the major influence on local customs, religion, and language by the Spanish elsewhere, the absence of such influence in Hawai'i should be taken as evidence that the Spanish never landed. Similarly, the absence of any Spanish artifacts can also be taken as negative evidence for a landfall. To be sure, in the majority of cases where Spanish influence was pervasive among indigenous cultures, the initial contact was made by conquerors, missionaries, and traders whose goal was to spread such influence. In contrast, the scenario of ship-wrecked sailors arriving in Hawai'i, with nothing but the clothes they wore, may explain both a lack of artifacts and records documenting such contact. In short, there is no evidence to support a pre-Cook Spanish landfall in Hawai'i, but, it appears that the hypothesis cannot be refuted at this time, either.

A variant of this second hypothesis suggests that tuberculosis first arrived in the Marquesas with the Spanish explorer Quiros in 1595, and that the bacillus reached Hawai'i through voyaging to and from the Marquesas (directly or via the Society Islands) sometime after 1595. This subsidiary hypothesis necessarily requires that two-way voyaging between Hawai'i and Central-Eastern Polynesia was still going on at that time—or, at a minimum, that there was at least a one-way trip to Hawai'i. Oral tradition places two-way voyaging in the 14th and 15th centuries (Suggs 1960). These dates fall at least a century short of the time of Quiros' arrival in the Marquesas. As for any skeletal evidence of tuberculosis in the Marquesas in the 16th century A.D., there are, as of this writing, no human remains known to date from that time period.

Acquired Through Contact with the Americas

The presence of tuberculosis in pre-Columbian North and South America is well-established. The bacillus has been documented by pathologic changes in soft tissue as well as in the skeletal remains of mummies from Peru and Chile, and by the discovery of the bacteria in the soft tissue (Allison et al., 1981). In North America, tuberculosis has been reported in firmly dated, pre-contact remains from Tennessee, Ohio, Illinois, and Ontario, with dates beginning in the 13th century A.D., and in the desert southwest with dates from the 9th through 15th centuries A.D. (Merbs 1992; Buikstra 1979). The rarity of tuberculosis in remains which date prior to A.D. 1000 is attributed to the fact that tuberculosis tends to be dependent on denser populations, rather than the more sparsely settled habitations of earlier times.

One strong piece of evidence links pre-contact Hawai'i with the Americas: the pre-contact presence of the sweet potato, a plant native to the New World. Columbus discovered it in the Greater Antilles on his first voyage, and 16th century A.D. Spanish explorers documented its presence in indigenous Peru. Incan pottery from about A.D. 500 is decorated with drawings of sweet potato plants

(Yen 1974). The presence of sweet potato in either Asia or Europe before Columbus cannot be documented, and, in fact, there is only evidence of its introduction to both continents after 1492 (Yen 1974).

Yet, the sweet potato was present in pre-contact Polynesia. The cultigen was not a Spanish introduction because where this was the case, as in Latin America, the plant is called the "camote." In Polynesian languages, the names for sweet potato are all cognates of the Quechuan (highland Peru) name "kumara." This linguistic evidence alone indicates that transmission of sweet potato to the Pacific could not have been effected by birds or other natural agents. The sweet potato came to the Pacific by human agency, and the fact that sweet potato had a widespread, pre-contact distribution throughout Polynesia—from Easter Island to New Zealand to Hawai'i—suggests an early introduction, perhaps to the Marquesas. Yen (1974) postulates transmission of the sweet potato from Peru to Central-Eastern Polynesia, the Marquesas, Society Islands, and Cook Islands, with dispersal from these islands to Western Polynesia and to Easter Island, New Zealand, and Hawai'i. Yen (1974) states, however, that genetic studies fail to identify any one island group in which the sweet potato varieties exhibit the complete genetic variability found in Polynesian sweet potato varieties, and could therefore serve as the source of all genetic variation in the cultigen.

A second piece of evidence linking Oceania with the Americas is the presence of the coconut (*Cocos nucifera*) in South America. The coconut probably originated in Southeast Asia or Melanesia, and was present in the Panama-Columbia area at least by A.D. 1500. Although the coconut floats, washes up on beaches, and is adapted to a beach environment, experiments have shown that after being in the ocean water for the length of time required to reach South America, there is almost no likelihood of germination (Howe 1984; Finney 1979). Consequently, human agency would be required to effect any significant dispersal of the coconut.

A third, and less substantive piece of evidence for pre-Cook human contact between Polynesia and South America is the reported discovery of Polynesian artifacts in Chile and Argentina. The archaeological contexts of these finds, however, are in every case uncertain (Suggs 1960). There is also, however, linguistic evidence of an artifactual "exchange." While the Polynesians borrowed the work "kumara" for the sweet potato, the Marquesan word "toki" is used by certain Chilean Indians for stone adzes that are similar to Polynesian types (Suggs 1960).

Given the now-established Polynesian record for ocean-voyaging, it seems more likely that the Polynesians made landfall in the Americas, than that native Americans voyaged to Polynesia. The Polynesians had already proven themselves to be very able seamen, and their canoes were seaworthy. By A.D. 1000, the Polynesians had already covered a large part of the Pacific Ocean, reaching such distant points as Easter Island and Hawai'i which were, respectively, some 1,500 and 2,000 miles from the nearest land mass. Certainly, two-way voyaging between Eastern-Central Polynesia and the Americas was well within the ethos and ability of the Polynesians.

In considering this third hypothesis, the same problems arise as in previous discussions of the first and second hypotheses of transmission of tuberculosis to Hawai'i. If tuberculosis reached Hawai'i via the same route as the sweet potato, one would expect to see some evidence of it elsewhere in Polynesia, at least in the Marquesas. The number of pre-contact human skeletons from the Marquesas examined to date is few, so a lack of evidence may be seen as a failure to look for it. A corollary hypothesis would be the supposition that Polynesian voyagers made multiple return journeys to South America. Thus, the trip on which the sweet potato was brought back was not perhaps the same landfall during which the tuberculosis bacillus was contracted.

Finally, the epidemiological nature of tuberculosis should be considered. Humans have some degree of natural immunity to the disease in that not everyone exposed to tuberculosis becomes ill. Many people with positive tuberculin skin tests (indicating exposure and antibody formation) have never had tuberculosis, either pulmonary or other forms. Overall good health and nutrition play important roles in this natural immunity. Tuberculosis tends to flourish in crowded or urban settings where nutrition is poor, or people are already debilitated by other diseases. While lack of adequate sampling may still be

the principal reason for lack of evidence of tuberculosis elsewhere in Polynesia, this epidemiological pattern may also partly explain the low incidence.

The subject of epidemiological patterning also brings up the question, why Maui? Even in a very large sample on O'ahu, evidence of tuberculosis is questionable (Johnson & Kerley 1974). There is no evidence of the infection in a sample of 340 probable pre-contact burials from Keōpū, Kona on the Island of Hawai'i (Collins 1986). Yet on Maui, there are least 10 cases of skeletal tuberculosis in two samples totaling slightly over 900 individuals. If five to seven percent of individuals with pulmonary tuberculosis developed skeletal lesions, then 140 to 200 of the 900 individuals suffered from tuberculosis. The figure of 10 cases is a minimum, and non-diagnostic cases could double that figure.

In considering these inter-island differences, a number of questions arise concerning the potential explanations. Were living conditions on Maui so different as to cause tuberculosis to flourish when it did not on other islands? Was the population density greater? Were there other epidemiological factors unique to Maui? Did the people of Maui immigrate from a different place or at a different time, carrying with them a unique pattern of health and disease? Did people from Maui make a two-way voyage to somewhere in the Americas and bring back tuberculosis? Did our hypothetical crew of shipwrecked Spanish sailors land on Maui? All of these questions are beyond the scope of this paper, but they do indicate the complexity of the issues, and suggest directions for future research in both archaeology and physical anthropology.

Conclusion

That tuberculosis was present in Hawai'i before Captain Cook's arrival cannot be seriously doubted. Three hypotheses regarding the route of transmission to Hawai'i have been considered here. Given the current level of bio-medical evidence, none can be proven and none can be refuted. In addition to answering questions such as those posed above, future research directions may well be guided by improving analytical techniques in biomedical research.

References

Allison, M. J., E. Gertzen, J. Munizaga and M. Gonzales. 1981. Tuberculosis in pre-Columbian Andean populations. In *Prehistoric tuberculosis in the Americas,* ed. J. Buikstra. Evanston, IL: Northwestern University Archaeological Program.

Bayard, D. T. 1968. Excavations at Non Nok Tha, Northeastern Thailand. *Asian Perspectives* 13: 109–143.

Beaglehole, J. C. 1966. *The exploration of the Pacific.* Palo Alto: Stanford University Press.

Bellwood, P. 1979a. *Man's conquest of the Pacific.* New York: Oxford University Press.

———. 1979b. The Oceanic context. In *The prehistory of Polynesia,* ed. J. D. Jennings. Cambridge, MA: Harvard University Press.

Bowen, R. N. 1974. Mōkapu: Its historical and archaeological past. In *Early Hawaiians. An initial study of skeletal remains from Mōkapu, Oahu,* by C. E. Snow. Frankfort, KY: University Press of Kentucky.

Brothwell, D. and A. T. Sandison. 1967. *Diseases in antiquity.* Springfield, IL: C. C. Thomas & Sons.

Buikstra, J., ed. 1979. *Prehistoric tuberculosis in the Americas.* Evanston, IL: Northwestern University Archaeological Program.

Collins, S. L. 1986. Osteological studies of human skeletal remains from the Keōpū burial site. In *Moe kau a ho'oilo. Hawaiian mortuary practices at Keōpū, Kona, Hawai'i,* by T. Han, S. L. Collins, A. Garland and S. D. Clark. Departmental Report Series 86–1. Honolulu: Dept. of Anthropology, B.P. Bishop Museum.

Daws, G. 1968. *Shoal of time.* Honolulu: University of Hawaii Press.

Finney, B. R. 1979. Voyaging. In *The prehistory of Polynesia,* ed. J. D. Jennings. Cambridge, MA: Harvard University Press.

Fornander, A. 1878–1885. *An account of the Polynesian Race.* London: Trubner & Co.

Green, R. C. 1979. Lapita. In *The prehistory of Polynesia,* ed. J. D. Jennings. Cambridge, MA: Harvard University Press.

Houghton, P. 1980. *The first New Zealanders.* Auckland: Hodder & Stoughton.

Howe, K. R. 1984. *Where the waves fall.* Honolulu: University of Hawaii Press.

Howells, W. W. 1973. *The Pacific Islanders.* London: Weidenfeld & Nicholson.

———. 1979. Physical anthropology. In *The prehistory of Polynesia,* ed. J. D. Jennings. Cambridge, MA: Harvard University Press.

Hummert, J. R. in prep. *Human skeletal and dental remains from the Grand Hyatt site, Wailea, Land of Paeahu, Makawao District, Island of Maui.* Hilo: Paul H. Rosendahl, Ph.D., Inc.

Jennings, J. D., Ed. 1979. *The prehistory of Polynesia.* Cambridge, MA: Harvard University Press.

Johnson, L. C. and E. R. Kerley. 1974. Report on pathological specimens from Mōkapu. In *Early Hawaiians. An initial study of skeletal remains from Mōkapu, Oahu,* by C. E. Snow. Lexington, KY: University Press of Kentucky.

Kelley, M. A. and M. S. Micozzi. 1984. Rib lesions in chronic pulmonary tuberculosis. *American Journal of Physical Anthropology* 65: 381–386.

Kirch, P. V. 1988. Problems and issues in Lapita archaeology. In *Archaeology of the Lapita cultural complex: a critical review,* ed. P. V. Kirch and T. L. Hunt. Research Report 5. Seattle, WA: Thomas Burke Memorial Washington State Museum.

Kirch, P. V. and T. L. Hunt 1988. The spatial and temporal boundaries of Lapita. In *Archaeology of the Lapita cultural complex: a critical review,* ed. P. V. Kirch and T. L. Hunt. Research Report 5. Seattle, WA: Thomas Burke Memorial Washington State Museum.

Kirk, R. E. and E. Szathmary, Eds. 1989. *Out of Asia: peopling of the Americas and the Pacific.* Canberra: Journal of Pacific History.

Merbs, C. F. 1992. A new world of infectious disease. *Yearbook of Physical Anthropology* 35: 3–42.

Ortner, D. J. and W.G.J. Putschar. 1981. *Identification of pathological conditions in human skeletal remains.* Washington, D.C.: Smithsonian Institution Press.

Owsley, D. W., G. W. Gill and S. D. Ousley. 1994. Biological effects of European contact on Easter Island. In *In the wake of conquest: Biological responses to conquest,* ed. C. S. Larsen. New York: Wiley-Liss.

Pawley, A. and R. C. Green. 1985. The Proto-Oceanic language community. In *Out of Asia: peopling of the Americas and the Pacific,* ed. R. Kirk and E. Szathmary. Canberra: Journal of Pacific History.

Pietrusewsky, M. 1970. An osteological view of indigenous populations in Oceania. In *Studies in Oceanic Culture History,* ed. R. C. Green and M. Kelly, 1–11. Pacific Anthropological Records 11. Honolulu: Department of Anthropology, B. P. Bishop Museum.

———. 1974. *Non Nok Tha: The human skeletal remains from the 1966 excavations at Non Nok Tha, Northeastern Thailand.* Otago University Studies in Prehistoric Anthropology 6. Dunedin: Department of Anthropology, University of Otago.

———. 1976. *Prehistoric human skeletal remains from Papua New Guinea and the Marquesas.* Honolulu: Social Sciences and Linguistics Institute, University of Hawaii at Manoa.

———. 1977. Study of relations between populations of the Pacific using multivariate analysis of cranial variation. *L'Anthropologie* 81: 67–97.

Pietrusewsky, M., M. T. Douglas, P. A. Kalima and R. M. Ikehara. 1990. *Human skeletal remains recovered from 'Anaeho'omalu, South Kohala, Hawai'i Island: A second study.* Hilo: Paul H. Rosendahl, Ph.D. Inc.

———. 1991 *Human skeletal and dental remains from the Honokahua burial site.* Hilo: Paul H. Rosendahl, Ph.D., Inc.

Snow, C. E. 1974. *Early Hawaiians. An initial study of skeletal remains from Mōkapu, Oahu.* Lexington, KY: University of Kentucky Press.

Solheim, W. G., R. H. Parker, and D. T. Bayard. 1966. Progress report of the 1966 excavations at

Non Nok Tha. Ms. on File at the Department of Anthropology, University of Hawai'i at Manoa, Honolulu.

Spriggs, M. J. T. 1985. The Lapita cultural complex: Origins, distribution, contemporaries, and successors. In *Out of Asia: Peopling of the Americas and the Pacific,* ed. R. Kirk and E. Szathmary. Canberra: Journal of Pacific History.

Steinbock, R. T. 1976. *Paleopathological diagnosis and interpretation.* Springfield, IL: C. C. Thomas & Sons.

Stokes, J.F.G. 1932. Spaniards and the sweet potato in Hawaii and Hawaiian-American contacts. *American Anthropologist* 34(4):594–600.

Suggs, R. C. 1960. *The island civilizations of Polynesia.* New York: New American Library.

Trembly, D. L. 1984. *Osteological analysis of human skeletal remains, Kukailimoku Beach, Kona, Island of Hawai'i.* Hilo: Paul H. Rosendahl, Ph.D., Inc.

———. 1993. Osteological Analysis. Appendix B. In *Archaeological inventory survey, makai portion of 'Ōhi'a Cave Historic Preserve, Keauhou-Kona Resort, Land of Kahalu'u, North Kona District, Island of Hawai'i,* ed. C. O'Hare and P. H. Rosendahl. Hilo: Paul H. Rosendahl, Ph.D., Inc.

Trembly, D. L. and J. Hummert. 1990. Osteological analysis of human skeletal remains. In *West Beach data recovery program phase 4 (mitigation) Ko Olina Resort, 'Ewa District, Island of O'ahu,* by P. H. Rosendahl. Hilo: Paul H. Rosendahl, Ph.D., Inc.

Tryon, D. T. 1985. Peopling the Pacific: A linguistic appraisal. In *Out of Asia: Peopling of the Americas and the Pacific,* ed. R. Kirk and E. Szathmary. Canberra: Journal of Pacific History.

Yen, D. E. 1974. *The sweet potato in Oceania.* B. P. Bishop Museum Bulletin 236. Honolulu: Bishop Museum Press.

Pre-Contact and Early Historic Cultural Landscapes in Kahikinui District, Maui: A Progress Report

Patrick V. Kirch and Cynthia Van Gilder

University of California, Berkeley

On the morning of May 28th, 1786, Jean-François de Galaup de la Pérouse in command of the French frigates *Boussole* and *Astrolabe* sighted the snow-covered summits of Mauna Loa and Mauna Kea and, soon after, that of Haleakalā. To la Pérouse "the island of Maui looked delightful," and he directed his ships to coast it one league offshore. La Pérouse and his sea-weary crew were enthralled with "waterfalls tumbling down the mountainside into the sea," as they passed the districts known to the Hawaiian inhabitants of Maui as Kīpahulu and Kaupō (Dunmore, ed. 1994:80). This idyllic landscape was soon replaced—much to the dismay of the sailors—as "the mountains receded towards the interior of the island." In la Pérouse's words,

> We saw no more waterfalls, the trees were fairly sparsely planted along the plain, and the villages, consisting only of 10 or 12 huts, were quite distant from each other. Every moment made us regret the country which we were leaving behind, and we only found shelter when we were faced with a frightful shore, where the lava had once run down as waterfalls do today in the other part of the island (Dunmore, ed. 1994:82).

This barren landscape which so disappointed la Pérouse and which occupies most of the southeastern sector of Maui was the traditional district of Kahikinui, 'Great Tahiti,' named—most probably—in memory of Tahiti in the Society Islands. Lying in the lee of 1,215-meter high Haleakalā, Kahikinui is a classically leeward, arid landscape, its lava flow-slopes barely modified by a few narrowly-incised, intermittent stream gulches.

La Pérouse's disappointment with southeast Maui may be taken as a metaphor for the post-contact history of Kahikinui District. Rapidly depopulated during the

early nineteenth-century through the devastation of epidemics and the lure of out-migration to such centers as Lahaina, Kahikinui soon became a forgotten hinterland, famous only as the refuge of persecuted Catholics under the Protestant-dominated regimes of the successive *Kuhina Nui* Ka'ahumanu and Kīna'u. These converts to the Catholic faith gained notoriety in 1837 when—refusing to convert to Protestantism—they were *pa'a kaula* (tied with ropes) and marched to Wailuku via Hāna, a judicial action that backfired completely as a crowd of 2,000 joined their ranks along the course of the march (Matsuoka et al. 1995:III-127). In the Great Mahele of 1848, the entire *moku* or district of Kahikinui was surrendered to the Hawaiian Government by Lot Kamehameha (later King Kamehameha V) in lieu of commutation due on other lands received by this high chief and grandson of the great conqueror (Commissioner of Public Lands 1929:37). Being of little economic use to the Government, Kahikinui's lands were subsequently leased to *haole* cattle ranchers, a practice which continued throughout this century even after the passage of the Hawaiian Homes Act of 1920. The indigenous Hawaiian population of Kahikinui wholly abandoned its grassy slopes to the depredations of cattle by about 1865, when the little Catholic Church of St. Inez in Nakaohu *ahupua'a* was abandoned for lack of a congregation.

A cattle-ranching, unpopulated hinterland throughout the twentieth century, Kahikinui has also been largely bypassed by archaeologists. In 1929 Winslow Walker, a Yale-Bishop Museum Fellow assigned the task of surveying Maui archaeology (Buck 1945:57; Walker 1931), passed through the region on horseback recording a few *heiau* sites pointed out to him by his Hawaiian guide. Aside from a brief test excavation at a cave site in Mahamenui by K. P. Emory in 1961 (Chapman and Kirch 1979:19), Kahikinui received no attention in the renewed program of Hawaiian archaeology directed by Emory after 1950. In 1966, however, Kahikinui became the focus of a major archaeological survey effort directed by Peter S. Chapman, at the instigation of Emory (Kirch 1985:137–38). The Chapman team carried out intensive archaeological survey within two *ahupua'a* (Kīpapa and Nakaohu) as well as reconnaissance work throughout the district, and excavations at six sites within Kahikinui (Chapman and Kirch 1979). For reasons described below, most of this work was never completed or published, and Kahikinui once again was ignored in favor of other field settings.

Within the past two years, Kahikinui has again begun to attract attention, both from Native Hawaiians and from archaeologists. With the rise of a Sovereignty movement among Hawaiians, the vast, underutilized Kahikinui lands have become something of a political symbol, and the focus of a grassroots organization, Ka 'Ohana o Kahikinui. The Kahikinui Ohana proposes to reestablish a Hawaiian community within Kahikinui, which would include traditional land use practices. Responding to the likelihood that at least some Kahikinui lands would be released from cattle ranching to homesteading, the Hawaiian Homes Commission has engaged archaeologists to assess the extent of cultural resources, and to determine how these might be impacted by changes in land use (M. Kolb, pers. comm. 1994; Hammatt and Folk 1994). The possibility of a geothermal energy transmission line being routed across southeast Maui also prompted a cultural resources study of a narrow corridor from Huakini Bay to Ahiki (Erkelens 1995).

It was largely serendipitous that in this context of renewed interest in Kahikinui the senior author had decided in 1993 to begin a reanalysis of the Chapman survey data dating to 1966. Having been a member of the 1966 survey team, he had long harbored an interest in seeing that pioneering study brought to fruition. During 1995, we were able not only to rework and field check much of the 1966 survey data, but to extend the survey in Kīpapa and Nakaohu *ahupua'a* into areas not covered during the Chapman project. This article is a summary report of our progress to date.

Kahikinui: Environmental Background

Kahikinui District occupies the southwestern flanks of East Maui, surmounted by the 10,023-foot summit of Haleakalā. The land surface is dominantly undissected lava flow slopes of the Hāna Volcanic Series, derived from the southwest rift of Haleakalā, dotted in a few places with pyroclastic vents such as the Lualailua cinder cones (Stearns and Macdonald

1942; Macdonald and Abbott 1970:318–36). The young age of the Hāna lava is indicated by their lack of weathering, especially stream dissection. Stream gulches only become prominent towards the eastern edge of Kahikinui, where an older land surface of the Kula Volcanic Series was not buried under the late Pleistocene or Holocene Hāna series flows. Lithologically, the Hāna lavas include alkalic olivine basalts, basaltic hawaiites, and ankaramites. Within our Kīpapa-Nakaohu survey area, two or three ankaramite flows of different ages are suggested by lithology and degree of surface weathering. These flows vary locally in terms of a‘a or pahoehoe morphology, a factor that has greatly influenced the degree of surface weathering, especially in the upland zones.

Because this landscape is geologically youthful, it has been only slightly modified by erosion. Within our survey area there are a few intermittent stream channels ranging from 2–8 m in width, with scoured and smoothed channel floors and small quantities of waterworn gravel indicative of water flow at times. None of these channels flow regularly now, although there may have been more frequent discharge in pre-contact times when the forest line was significantly lower, prior to the depredations of cattle and goats. These intermittent streams would have provided the only sources of surface water to the pre-contact Hawaiian population of Kahikinui. Slightly east of the Kīpapa-Nakaohu survey area is Kepuni Gulch, where the U.S.G.S. has a gauging station; from May 1963 to September 1965, the Kepuni stream had measurable discharge on only four days (U.S.G.S. 1971:363).

The rainfall gradient between the Haleakalā summit and the coast is steep. No good rainfall records exist, however, and rainfall is extrapolated from stations at ‘Ulupalakua to the west and Waiopai Ranch to the east. The upland zone between about 2–4,000 feet elevation is estimated to receive 750–1,000 mm annually, mostly in the winter months; this is probably highly variable from year to year. This amount of rainfall has been sufficient to weather the older a‘a lava flows. The coastal sectors are extremely arid, as indicated by the lack of weathering of their lavas.

The upland portions of Kahikinui District still support the remnants of a once-remarkable dryland forest, noted for its diversity of endemic trees and shrubs, but now sadly degraded through the effects of feral pigs, goats, and cattle (Medeiros, Loope, and Holt 1986). In our Kīpapa-Nakaohu study area, the uplands between ca. 365–740 m elevation are dominated by a mix of exotic grasses, lantana (*Lantana camara*), and *koa haole* (*Leucaena glauca*). However, significant numbers of such native species as *wiliwili* (*Erythrina sandwicensis*), *‘ili-ahi* (*Santalum* spp.), and *a‘ali‘i* (*Dodonea eriocarpa*) also persist. The lower elevations and coastal region are more barren, although scattered *wiliwili* and *a‘ali‘i* grow to within a few hundred meters of the coast.

The littoral and marine resources available to the pre-contact and early historic inhabitants of Kahikinui were extremely restricted in comparison with other parts of Maui. The coastline is dominated by sea cliffs ranging from a few meters to 30–50 m high, making access difficult except in a few locations where there are small bays with cobble or gravel beaches; these bays are all marked by concentrations of archaeological sites. There is no fringing reef, and the ‘Alenuihāhā Channel is noted for its strong currents and rough seas, making fishing from small canoes hazardous. Surge zone mollusks such as the prized *‘opihi* (*Cellana exarata*), small cowries (*Cypraea caputserpentis*), and drupes (*Drupa ricinus*), and sea urchins were gathered from the sea cliffs and lava rock benches, and octopus are evidently common in the shallower waters immediately offshore (cowry-shell lures and “coffee-bean” type sinkers are among the most commonly found surface artifacts at Kahikinui sites).

The 1966–67 Chapman/Bishop Museum Survey

During the summer months of 1966 and in January 1967, an archaeological survey of portions of Kīpapa and Nakaohu *ahupua‘a* was undertaken under the direction of Peter S. Chapman, then an anthropology graduate student at Stanford University. Officially under the auspices of the Bishop Museum, the survey was in large measure privately financed by Chapman. Tragically, Chapman became terminally ill a few years after the survey was carried out, and died before his intended dissertation or any final report could be prepared.

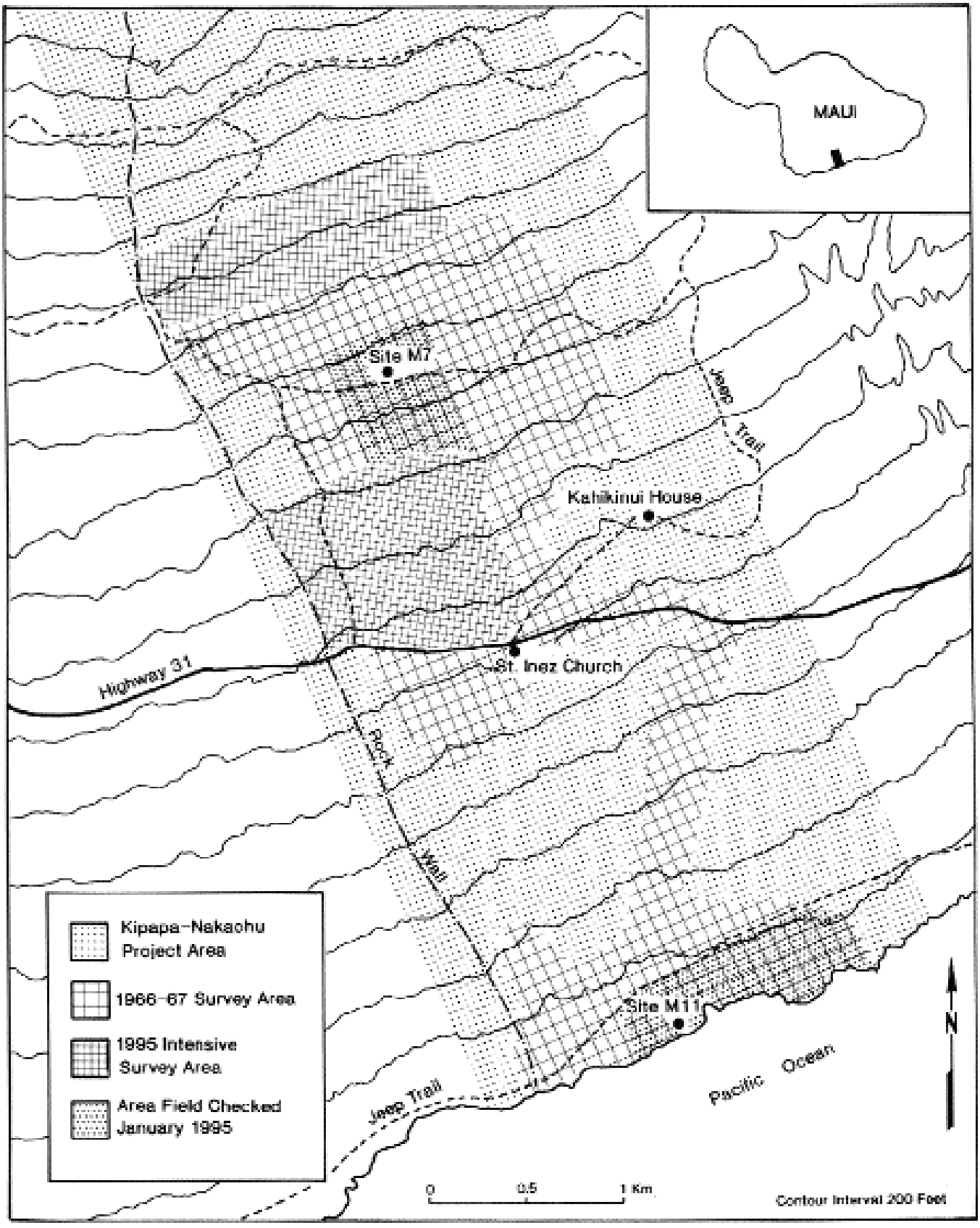
The 1966–67 survey was a pioneering effort in Hawaiian archaeology. Most prior survey work in Hawai'i had been highly selective, focused almost exclusively on monumental sites such as *heiau* and fishponds (such as the 1929 work of Winslow Walker [1931] on Maui.) Influenced by methodological and theoretical innovations taking place in the Americas and elsewhere, especially the emerging "settlement pattern" approach of Harvard archaeologist Gordon Willey and his students such as K. C. Chang and R. C. Green, Chapman decided to undertake an *intensive* or comprehensive archaeological survey of two *ahupua'a* units. The main theoretical inspirations to the 1966 Kahikinui survey were Green's work in the Society Islands and Samoa (Green 1967, 1970), and Ruppé's example from the American Southwest (Ruppé 1966). Chapman's aim was to record *all* archaeological remains visible on the surface, no matter how mundane, in order to gain a greater understanding of the patterns of traditional land use, settlement distribution, and sociopolitical organization. The 1966–67 Kahikinui survey was the first effort of this type in the Hawaiian Islands, although it would shortly be followed by similar settlement-pattern work in such areas as Mākaha, O'ahu (Green 1969), Halawa, Moloka'i (Kirch and Kelly 1975), and Lapakahi, Hawai'i (Pearson, ed. 1968; Tuggle and Griffin 1973; Rosendahl 1972).

Since there was no precedent in Hawai'i for this kind of intensive survey, the 1966 field team had to develop its own data-recording protocols. The system developed by Chapman consisted of systematically walking the landscape, marking each archaeological feature or site as it was discovered and assigning these with sequential numbers. An instrument survey team (W. Kikuchi and P. Kirch) then mapped these sites using plane table and telescopic alidade at a scale of 1″ = 200′. The plane table survey sheets were later compiled by Kikuchi into a composite archaeological "settlement pattern" map of Kīpapa-Nakaohu. Meanwhile, a second team made individual sketch maps of the sites or features (using compass and tape, or sometimes by pacing), noting dimensions and making other observations. These sketches were mostly made on graph paper at various scales, although recording standards were by no means consistent; no verbal descriptions were made. Selected photographs were also taken by Chapman. In sum, the records of the 1966–67 survey consist of the plane table maps, and individual feature/site sketches augmented by selected photographs.

Although Chapman's original intention was to survey both Kīpapa and Nakaohu *ahupua'a* entirely, this proved beyond the resources of his 1966 project. As can be seen in Figure 1, his team succeeded in covering a large portion of the *mauka* zone (above the highway), as well as the coastal strip. A transect running along a *mauka–makai* jeep trail was also surveyed. In all, a total of 544 sites or features was recorded and assigned site numbers in 1966–67. Although Chapman's survey was highly innovative for its time, from our contemporary perspective the level of data recording was less than satisfactory. The individual site/feature sketches vary in quality and level of detail; no verbal descriptions were written; observations of architectural patterns, surface midden or artifacts were not always systematic; and, there is no comprehensive photo record. Nonetheless, the 1966–67 survey does provide a wealth of data, and forms the basis upon which a renewed program of intensive survey in Kahikinui can build.

The U. C. Berkeley Kahikinui Project: Background and Objectives

In 1994, with the assistance of Cynthia Van Gilder, we began to reanalyze the 1966 survey data by developing a systematic, computerized relational database. The 1966 field sketches were each scrutinized for data on feature type, architecture, dimensions, and other observations, which were then systematically coded into a data file using the Paradox 4.0 relational database software, running on a DOS-386 platform. As this work proceeded, problems and inconsistencies with the 1966 survey records became increasingly apparent. Often it was not possible to assign a feature to a particular architectural or formal class, or to make informed decisions about probable function. It became evident that if the 1966 survey data were to be properly utilized, renewed field checking would be essential. We therefore planned a 10-day fieldwork session in Kīpapa-Nakaohu for January, 1995, to re-evaluate the 1966 survey results.


MAUI
Site M7
Jeep Trail
Kahikinui House
St. Inez Church
Highway 31
Rock Wall
Site M11
Jeep Trail
pacific Ocean
N
Kipapa-Nakaohu Project Area
1966-67 Survey Area
1995 Intensive Survey Area
Area Field Checked January 1995
0
0.5
1 Km
Contour Interval 200 Feet

Our January 1995 survey was envisioned as a "trial run" to revisit and field-check as many of the 1966 sites as possible. We wanted to determine: (1) how readily the 1966 sites could be relocated, and how accurate the map locations were; (2) to check for the accuracy of the 1966 field sketches and dimensions; (3) to record systematically certain architectural and other observations not made in 1966; and (4) to photograph as many sites as possible. We were constrained by both the limited funds and the time available, and did not anticipate that it would be possible to recheck anywhere near the total of 544 sites. Our aim was more modest: to visit as many features as possible in both *mauka* and *makai* sample areas.

Between January 3–12, 1995, we spent seven days in the Kīpapa-Nakaohu area (two days were spent in the coastal sector, and five in the uplands). The field team consisted of the author, U. C. Berkeley graduate students Cynthia Van Gilder and Kathy Kawelu, and undergraduate student Greg Reuter. Our field strategy was to work in two teams, each assigned a particular mapped area from the 1966 survey. We used xerox reproductions of the 1966 plane table sheets to relocate sites, and had bound sets of the individual site sketches for rechecking. We made systematic architectural observations on a preprinted recording form, using a protocol originally developed for an intensive survey of the Kawela *ahupua'a,* Moloka'i (Weisler and Kirch 1985).

The January pilot study showed that the 1966–67 sites could readily be relocated, and that with systematic cross-checking the original data could be more readily interpreted. We were thus encouraged to lay plans for a longer-term restudy of the Kīpapa-Nakaohu area with the ultimate goal of realizing Peter Chapman's initial vision of a comprehensive settlement-pattern study of these two *ahupua'a.* The second phase of this restudy was carried out from 29 June through 5 August, 1995 by the U. C. Berkeley team, assisted by staff of the State of Hawai'i Historic Preservation Division. Rather than continue to focus on rechecking 1966–67 sites, we decided to concentrate on the survey and recording of sites in areas not covered by the Chapman team. In particular, we chose to survey a large block of approximately 1 km^2, *mauka* of Highway 31 and extending east from a rock boundary wall through Kīpapa and into Nakaohu *ahupua'a.* In addition, we also extended the survey into a higher-altitude zone (above the pipeline which marked the upper boundary of the 1966–67 survey area). By the close of the 1995 field season, we had recorded 462 new sites, bringing the total for Kīpapa-Nakaohu to 1,006 sites.

Figure 1. Topographic map of a portion of Kahikinui District, showing the Kīpapa-Nakaohu survey area, and the extent of archaeological survey coverage (1966 and 1995 seasons). Topography based on U.S.G.S. Lualailua quadrangle.

Field and Laboratory Methods: 1995 Survey

The field and laboratory methods which we devised for the 1995 survey, and which will be used in our continuing efforts in Kīpapa-Nakaohu, are designed to take advantage of the best aspects of traditional archaeological field survey, combined with modern technological advances in data capture, storage, and analysis. A significant pre-fieldwork innovation consisted of scanning and digitizing a series of enlarged, color infrared aerial photographs. The photos had been taken for the State of Hawai'i Division of Forestry, and the enlargements made for us by Air Survey Hawai'i were at a scale of approximately 1:8,000. Once scanned and digitized, it was a simple task to delineate any area of interest on the computer screen, enlarge this to any desired scale, and to process and enhance the digitized image using several filtering or edge-enhancing features of the imaging software. Many archaeological sites, especially free-standing walls and larger structures, could readily be identified, as could distinctive vegetation patterns and other environmental features. Figure 2 depicts a cluster of historic-period house enclosures situated *mauka* of St. Inez Church, as revealed by a digitized and edge-filtered image. Before departing for the field, we prepared a comprehensive set of such digitized images which proved to be of great use during the field survey.

In the field, a reconnaissance team walked close transects, flagging structures for mapping and recording (no easy feat in some parts of the survey area with dense, head-high lantana). Several low-level heli-

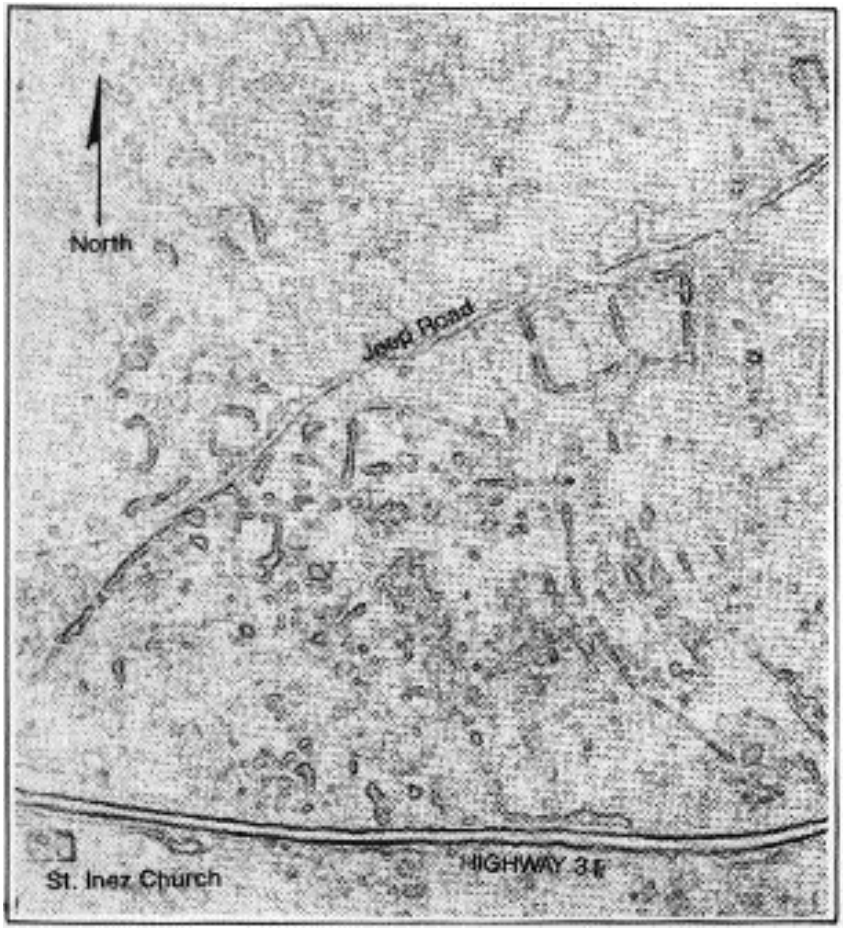


Figure 2. Example of an enlarged digitized, edge-filtered aerial photo of an historic village complex in Nakaohu *ahupua'a.* The image area is approximately 200 x 200 m.

copter flights over the survey area allowed us to obtain oblique photographs of sites and terrain. Reconnaissance was followed by the mapping team which, as in 1966–67, used a Gurley telescopic alidade and plane table to plot all sites at 1:1,000. The decision to map site locations by optical instrument was based both on a desire to maintain consistency with the 1966–67 maps, but also because plane table mapping allows one to make detailed and extensive observations on topography, geological substrate, and vegetation cover. Thus our 1:1,000 survey maps provide a basis for interpretations of remote-sensing data to be entered into our GIS (geographic information system) database for this region (see below). For most sites, moreover, we also electronically recorded site locations using a Trimble Global Positioning System instrument, with differential correction of coordinates supplied by the State Historic Preservation Office. GPS positions were also taken on all plane table mapping stations.

Once sites were mapped, plotted, and numbers assigned, they were recorded in detail by a third team, using standardized, pre-printed recording forms. The four-page form (printed on a single, folded sheet of stiff, green, non-reflective paper) incorporates a metric grid for plan and two cross-sections (usually drawn at 1:100), a check-list of 27 architectural, artifactual, and environmental features, and space for a verbal description. Use of such a pre-printed format greatly enhances the quality of data capture, and comparability of results between individual recorders, a problem also addressed by regularly conferring between field team members. A few large, architecturally-complex sites were also mapped in detail with plane table and alidade at 1:100 or 1:200.

In the post-field laboratory analysis phase, our survey data are entered into a relational database using Paradox, running in Windows 2.0 on a DOS-386 platform. The 1995 Paradox survey file is a slightly modified version of that developed for the 1966 survey data, incorporating all observations made on the pre-printed recording forms. We are also digitizing the site location maps (using AUTOCAD and an IBM 5084-3 digitizer as the input device), as the first phase of developing a GIS database for the Kīpapa-Nakaohu area. Our objective is to create a GIS database which combines the archaeological survey map with infra-red images from aerial photography, a digital elevation model, and additional information "layers" on geology, soils, vegetation, and other variables.

The Kīpapa-Nakaohu Survey: Results to Date

Architectural Variation and Problems of Site Classification

As in other leeward regions of Hawai'i, the archaeological landscape of Kīpapa-Nakaohu exhibits an initially bewildering array of stacked-stone architectural features, highly variable in morphology, ranging in

Figure 3. Helicopter aerial photo of a settlement cluster in the coastal zone. The smaller of the two rectangular enclosures (closer to the shoreline) is site M11, excavated in 1966.

size from 50-cm high stone mounds up to complex, walled, multi-component structures enclosing as much as 1,600 m^2. The effects of a century and a half of cattle ranching—resulting in collapse and heaping of many wall segments—further complicates architectural description. Having no precedents to inform him, Chapman struggled in 1966 with this architectural variation, defining such site types as "buttressed half-circles" (later to be called "C-shaped shelters" by most archaeologists), "walled rectangles," and "limited clearings." The problems of describing and classifying Hawaiian stone structural variation have continued in Hawaiian archaeology (e.g., Hommon 1970; Weisler and Kirch 1985; Ladefoged et al. 1987). In our 1995 fieldwork, we adopted a strict morphological system (modified from the 1980 Kawela survey on Moloka'i), noting probable functional attributions separately. In this brief summary paper, however, we cannot describe the range of morphological variation in detail, and our remarks on sites follow several very broad functional classes.

Patterns of Site Distribution

An exhaustive analysis of site distribution patterns must await the completion of the *ahupua'a*-wide survey and the GIS database. Yet several significant patterns are already evident. First, in broad areal terms three major zones of site distribution can be defined: (1) a coastal zone about 200–350 m wide, of relatively high site density; (2) an intermediate zone of low site density extending from the inland edge of the coastal zone to an elevation of about 340 m above sea level (about 2 km inland); and (3) an upland zone of very dense site concentration from about 340–750 m elevation. About 4.5 km from the coast, at 800 m elevation, site density drops off rapidly. The precise upper boundary of archaeological sites in the study area remains to be determined, in part due to the presence of a dense kikuyu grass (*Pennisetum clandestinum*) blanket that hinders site visibility at this altitude. However, our reconnaissance transects combined with low-level helicopter overflights suggest that relatively few sites will be found above 800 m elevation.

There can be no doubt that this zonal pattern is largely controlled by a few key environmental variables, especially rainfall and degree of surface weathering (and hence, soil development). The narrow zone of coastal sites is clearly related to marine-exploitation activities (Fig. 3), and most of these sites appear to have been only intermittently utilized. Sites in the intermediate zone are generally small and inconsequential (such as small shelters and *ahu*). It is in the dense upland zone that the majority of residential and ritual features are located, and here also that rainfall and soil development would have been adequate to support intensive cultivation of dryland crops such as sweet potato and taro. An unanswered question concerns the approximate location of the forest line in pre-contact times, and whether this correlated with the decrease in site density at about 800 m elevation. Today the remnant *Acacia koa* forest does not extend below about 1,300 m; it is well known, however, that there was significant forest

retreat in the past two centuries owing to the effects of cattle-ranching and other introduced animals (Medeiros et al. 1986:22–29).

Within the densely settled upland zone we have also been able to detect significant variation in site distribution and density. Tentatively, we believe that areas of high stone structure density correlate strongly with pahoehoe substrates, whereas areas with older and more deeply weathered a'a substrates are characterized by relatively low stone structure density. The weathered a'a substrates are also those dominated by grasses, and as noted below, in the Mahele records for Kahikinui we have some indication of grasslands being preferred areas for cultivation. It is entirely likely that residential activities were being purposively situated on areas of pahoehoe with low agricultural productivity (and high availability of loose building stone), leaving the more fertile soil areas free for intensive cultivation. This distribution pattern is of considerable interest archaeologically, for the a'a and pahoehoe substrates can be readily detected on our digitized infra-red images (due to differential reflectivity of vegetation covers), and may potentially provide the basis for predictive modeling of site density in other leeward areas of Maui or other islands using a GIS approach.

Agricultural Features

When intensive archaeological surveys of leeward parts of the Hawaiian archipelago commenced in the late 1960s, investigators were struck by the extent to which agricultural features often dominated the landscape (e.g., Newman n.d.; Green 1969). In particular, the leeward field systems of Hawai'i Island have attracted much attention (Kirch 1984:181–92, 1994:251–68; Kelly 1983; Rosendahl 1984). Given that Kahikinui is also a leeward, undissected, flowslope landscape it is all the more surprising that none of the regularized, linear field walls or terraces so typical of leeward Kohala or Kona are to be found in Kahikinui. Small stone mounds or heaps (ca. 0.5–2 m diameter) are, however, ubiquitous in the upland settlement zone in Kīpapa-Nakaohu. While settlement in parts of upland Kahikinui was unquestionably as dense as in leeward Hawai'i, there was evidently no effort to construct reticulate, stone-walled field systems.

What then, were the agronomic practices associated with what one can only assume must have been a system of fairly intensive cultivation, given the density of upland residential features? Our working hypothesis focuses on the likelihood that intensive field cultivation was practiced in two microenvironments of the uplands: (1) in areas of more deeply-weathered a'a, enriched in places with light ash fall, and marked in historic times by grassland vegetation; and (2) in the swale-like depressions found between undulating lava ridges. As noted below, the weathered a'a slopes have a significantly lower density of residential features; one such extensive area in the eastern part of Nakaohu is almost devoid of surface stone structures. There is some historic-period indication that such grassland-covered, weathered a'a substrates were preferred microenvironments for cultivation. In the adjoining and environmentally-similar district of Honua'ula, several Mahele claimants in 1847–48 explicitly counted "grasslands" among their core holdings. For example, Kala of Waipao submitted before the Land Commission his claim for "3 sections of grassland," noting that "2 have taro growing on them," and observing also that "the *haole*" had taken control of some of this acreage (Archives of Hawai'i, L.C.A. 2405, Native Testimony, 12/26/1847).

The swales which are typical of this undulating lava flowslope would also have provided suitable areas for cultivation. These vary in size, but are generally no more than about 50–75 m across, and about 3–10 m deep. They form natural sediment catchments, and we observed that lantana thickets growing in them today are more lush, and remain green even during the dry summer months. An objective for future research will be to stratigraphically section these swales for sedimentological and archaeobotanical indications of prior cultivation.

The most likely field crops cultivated in the Kīpapa-Nakaohu uplands would have been sweet potato (*Ipomoea batatas*) and taro (*Colocasia esculenta*), with bananas also a candidate in the protected swales. Douglas Yen, who visited the field site and consulted on possible prehistoric agricultural practices, has suggested that the early, pioneering stages of settlement and cultivation in Kahikinui may have been based on a "swidden-in-forest" system with taro as

Figure 4. A rectangular enclosure (site 44) in the uplands of Kīpapa.

the dominant crop (Yen, pers. comm., 21 Sept. 1995). As settlement became more intensive, however, one might anticipate the need to adapt this originally extensive system to changes in the degree of forest cover, wind exposure, and local moisture regimes. These are all matters that will require considerable study in the future phases of our project.

Residential Features

Features putatively associated with residential function exhibit the greatest range of architectural variability in the survey corpus, and are also the most numerous; they are therefore the most difficult to synopsize in a brief report such as this. Morphologically, they range from stone-faced terraces, to a variety of stone-walled windbreak shelters (linear, L-shaped, U-shaped, and C-shaped), to rectangular or square enclosures. Many incorporate natural outcrops and lava ridges in their construction, making it partly a subjective decision as to how to describe or classify them architecturally. In size, they are more consistent, generally falling within a maximum dimension of 4–8 m (16–64 m^2). The results of test excavations in six residential features are described separately, below.

Numerically, the most ubiquitous forms are clearly the windbreak shelters and the enclosures (both rectangular and square in plan view). Both of these classes are constructed of stacked lava cobbles, with frequent use of a "core-filled" construction method in which stacked outer and inner facings are in-filled with smaller a'a clinker. In the coastal zone, waterworn basalt gravel (*'ili'ili*) was used for paving interior surfaces, while in the uplands paved surfaces are of closely-fitted field stone. The shelters, whether they consist of a single linear wall segment, or of two or three walls, invariably have the longest and highest wall oriented perpendicular to the prevailing easterly wind. The protected or partially-enclosed living surface is then open to the west. Walled enclosures, only a relative few of which have formal entryways, also tend to have the highest or strongest wall to the east (Fig. 4). Walled enclosures in which wall heights reach approximately 1 m, and which are usually associated with larger enclosed spaces appear to us to be post-contact or historic period features, evidenced by surface finds of ceramics, bottle-glass, and clay pipe stem fragments. One large cluster of high-walled enclosures lies immediately NE of St. Inez Church, and may represent an early nineteenth-century settlement (Fig. 2).

There is some tendency towards clustering or aggregation of residential features, although in the uplands site density is so high that discrimination of discrete spatial clusters of features is at times difficult; on the coast more discrete clusters are apparent. One pattern that we have tentatively observed is a repeated group of three main features, which may on future investigation prove to be of some sociological significance.

Three major problems beset settlement-pattern analysis of residential structures: (1) chronology; (2) feature-use duration; and (3) function. Chronology is essentially the problem of establishing whether a series of features on the landscape were contemporary in their construction and use-lives. Feature-use duration is the problem of determining the use-life of a particular feature, and whether that use-life was continuous or temporary (intermittent). Function refers to the problem of ascertaining specific activities performed within or adjacent to a feature, a complex issue given the ethnohistoric record of con-

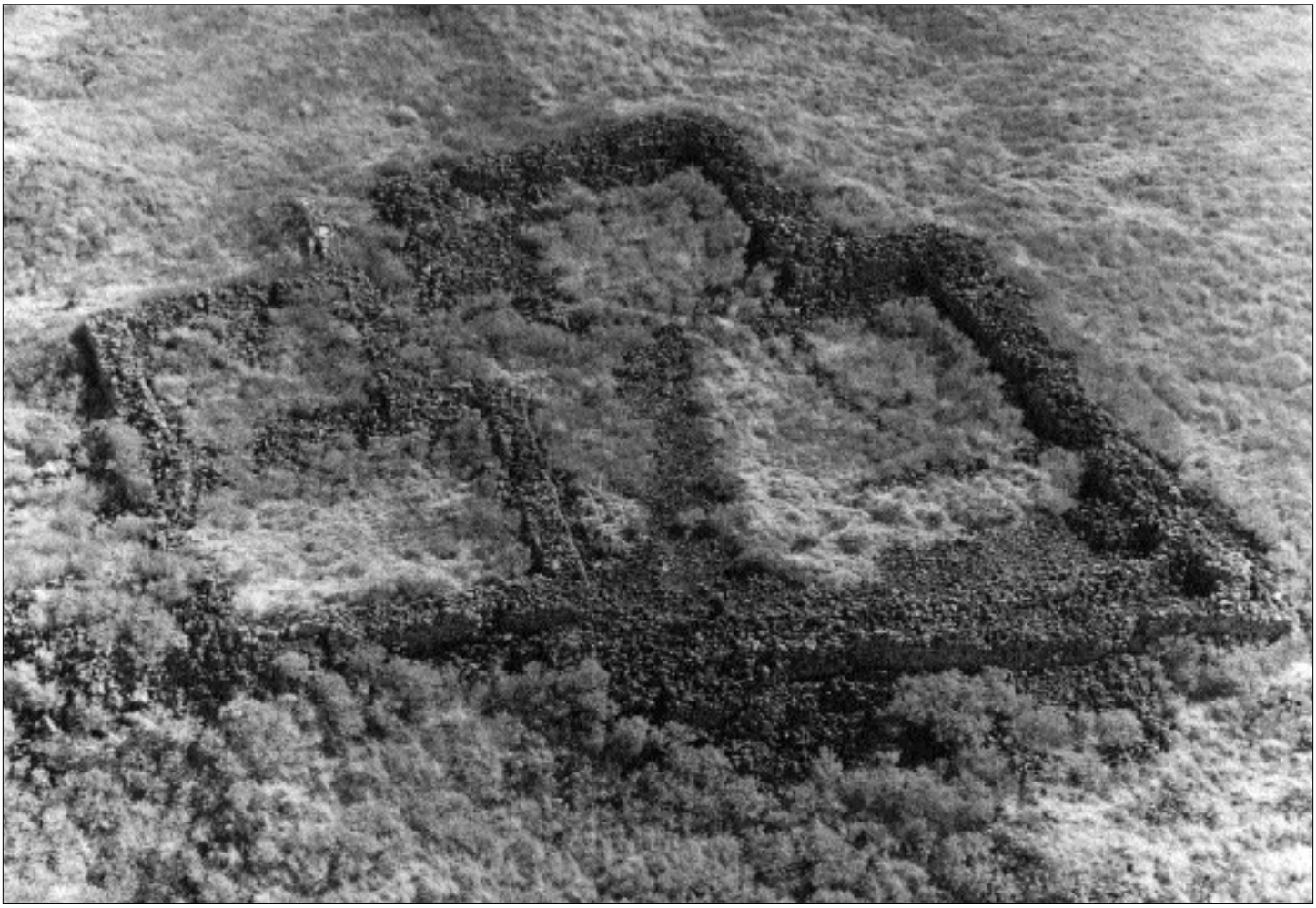


Figure 5. Helicopter aerial photo of the largest *heiau* within the Kīpapa-Nakaohu survey area (site 1010). The eastern portion of the structure (to the right in the photo) has the highest and most massive wall construction. Note that in plan the site consists of two "notched" enclosures, and may represent a two-phase construction sequence.

tact-period Hawaiian society in which the built environment was highly influenced by the *kapu* system. These are problems that we hope to tackle in earnest during subsequent phases of our project.

Ritual Features (*Heiau*)

Typically, religious or ritual sites (*heiau*) in Hawai'i are identified either through traditional or ethnohistoric sources, or by identification of architectural features thought to be characteristic of such sites (Kirch 1985:257–65). In Kahikinui, only a few sites were identified by Walker's Hawaiian guides in 1930 as being *heiau;* two of these lie within our survey area. On architectural criteria as well as size, however, at least another 15 structures within the Kīpapa-Nakaohu probably functioned as ritual sites. These range from a very large, architecturally-complex structure (ca. 1600 m^2) near the eastern boundary of Nakaohu *ahupua'a* (Fig. 5) which may well have been a district-level *heiau,* through intermediate-sized walled structures (ca. 200–800 m^2) often of "notched"

form (see Kolb 1994), down to small structures (ca. 75–150 m^2) that were probably either household shrines (*mua*) or—on the coast—fishing shrines (*ko'a*). A full analysis of the architectural variability within these structures will be presented elsewhere; here we confine ourselves to a few observations of note.

The mid-to-large sized *heiau* structures are all concentrated in the upland zone of dense site distribution (approximately 340–800 m elevation). With two exceptions, these are all stone-walled enclosures, usually having a six-sided ("notched") plan which has been noted by other archaeologists as typical of Maui Island *heiau* (Kolb 1994); the exceptions are terraced sites. Notably, all *heiau* sites exhibit a preferred orientation to the east, with the highest and best-constructed walls and facings at their eastern ends. Such an eastwards orientation was also noted by Weisler and Kirch (1985) as typical of ritual sites in Kawela *ahupua'a* on Moloka'i, and may represent a widely shared cultural ideology. Almost without exception, all ritual sites in Kīpapa-Nakaohu also have offerings of branch coral placed on them, or buried within wall fill; these coral offerings are exclusively of branch (not brain or block type) coral that was clearly gathered live from the sea. In the upland sites, these offerings usually consist of single branches, but on the coastal fishing shrines (*ko'a*) they are more numerous and include whole coral heads.

The distribution of *heiau* sites in the upland settlement zone is of particular interest. A number of smaller-sized notched enclosures are closely associated with clusters of residential features (linear, L-, and C-shaped structures) and may well have functioned as residential shrines or men's eating houses (*mua*). The intermediate-sized structures, however, are typically somewhat isolated from these residential clusters, suggesting that they may have been associated with stricter ritual prohibitions (*kapu*). Moreover, some six of these structures form a distinct *mauka–makai* cluster stretched out along a high a'a lava ridge in the middle of the survey area, immediately west of one of the most extensive tracts of deeply-weathered (and in part, ash-covered), arable soil. Our working hypothesis is that these intermediate-level *heiau* were each associated with individual *'ili*-level subdivisions of the *ahupua'a.*

Test Excavations

Test units were excavated in six sites in Kīpapa *ahupua'a,* four in the upland zone and two in the coastal area (Table 1), with the following goals in mind: (1) to obtain samples for radiocarbon dating; (2) to determine the state of preservation of subsurface materials; (3) to test for potential taphonomic differences between the coastal and upland zones; and (4) to provide an informed basis for planning more extensive excavations in future field seasons.

The six sites tested were chosen on the basis of several criteria. Only three sites (M7, M10, M11) had previously been tested in the survey area as part of the 1966 research (Chapman and Kirch 1979). In the upland zone, which has the densest concentration of sites, we chose two linear shelters (sites 742 and 440), a C-shaped shelter (site 37), and a rectangular enclosure (site 44, Fig. 4). In the coastal zone we sampled one L-shaped shelter (site 331) and a rectangular enclosure (site 335). We also selected sites with obvious surface scatters of midden and artifacts (such as 742) and those with no visible surface remains (such as 44). In two cases, the sites were chosen as pairs (sites 37 and 44; and sites 331 and 335, respectively) because they were in close enough proximity that it was felt they might represent structural elements of the same household cluster. In all sites, units were positioned against an interior wall with little or no structural tumble, allowing us to observe the stratigraphic relationships between wall and subsurface cultural deposit. The tests were purposefully limited in area (see Table 1). All excavated sediment was screened through 0.25-inch as well as 0.125-inch mesh.

The sediment at both the coastal and upland sites was a fine, dry, powdery, aeolian silt. Unless there was a concentration of ash, the cultural layers were marked not by a change in sediment texture, but rather by a slight darkening of sediment color. Two sites did contain ashy deposits, 37 and 742. In site 37, we noted a small (approximately 7 cm in diameter) concentration of ash with charcoal inclusions, but no artifactual associations. In site 742, one half of a stone-lined hearth was exposed in the test unit at approximately 23 cm below surface. We chose not to excavate the interior of the hearth at that time, but rather to cover the feature with the intention of

Table 1. Results of Kīpapa-Nakaohu Test Excavations (1995)

Category	Site 37	Site 44	Site 440	Site 742	Site 331	Site 335
Location Site Type	Upland C-shape shelter	Upland Rectangular enclosure	Upland Linear shelter	Upland Linear shelter	Coastal L-shape shelter	Coastal Rectangular enclosure
Test Area (m^2)	0.5	0.5	1	0.5	0.25	0.25
Thickness of Cultural Deposit (cm)	5	7	7	7+	4	Disturbed
Charcoal (g)	13.4	60.7	148.3	28.1	0	0
Bone (g)	0.1	0.2	0	0	0	0.6
Bone (NISP)	6	8	0	0	0	1
Marine Mollusk (g)	0.5	0	0.5	4.6	9.1	6.3
Land Snail (g)	0.1	0	0	0	0	0
Waterworn Coral (g)	0	0	23.1	0	10.4	1.3
Waterworn Basalt (g)	0	0	0	7.4	0	0
Basalt Flakes (#)	0	0	0	14	6	3
Aleurites Endocarp (g)	0	0	7.4	21.3	0	0

returning in the future when a more extensive exposure can be made.

In the other two upland sites, 44 and 440, the cultural layer was marked by a high concentration of charcoal, much of which is so well preserved that it will be possible to identify wood species. In contrast, the two coastal sites had little or no discernible cultural deposit. Site 331 had a very thin midden deposit contained with the top 10 cm of the site. At site 335 the excavation team noted the presence of modern goat feces throughout the first 20 cm of the test unit mixed with cultural materials; no intact cultural layer could be identified.

Only three of the sites excavated produced basalt lithics; in every case these were unretouched flakes. During surface survey, however, a small reworked adz was found at site 742. Another portion of a basalt adz was found on the surface of site 331, as well as a basalt awl. The highest concentration of marine shell was found at the two coastal sites, 331 and 335, and included the following species: *Drupa ricinus, Nerita picea, Cellana exarata, Thais* sp., *Cypraea* sp., and *Littorina* sp. In addition, two individuals of the land snail genus *Succinea* sp. were found at site 37. Faunal remains recovered included rat bones, among them an incisor of *Rattus exulans,* and two fishbones, including a fragment of the pharyngeal grinding plate of a labrid. Significantly, both of the fishbones were found at upland sites (37 and 44).

Summary

Building upon a pioneering settlement-pattern survey initiated by Peter Chapman in 1966, we have now completed an intensive survey of significant portions of two *ahupua'a* (Kīpapa and Nakaohu) in the little-studied Kahikinui District, Maui. More than 1,000 archaeological sites have been recorded and mapped, and systematic observations on architecture and other features recorded in a computer-

ized, relational database. These survey data are being combined with digitized aerial photographs, a digital elevation model, and other geographic information to form a GIS database for the survey area. We are now in the process of seeking grant funds to enable further field seasons, in order to complete the intensive ground survey throughout the project area, and to carry out extensive excavations in a variety of architectural features. Excavations will be essential to address problems of chronology, use-duration, function, and other matters. Although it has long been neglected by both historians and archaeologists, Kahikinui was once the setting for a large and vibrant Hawaiian population. It is our long-term goal to see that Kahikinui takes its rightful place in Hawaiian archaeology; in the process, we hope to add some new insights to our understanding of the historical development of Hawaiian culture and society.

Acknowledgments

We would like to thank the Department of Hawaiian Homes Lands for granting permission to carry out our fieldwork in Kahikinui; in particular, Carolyn Darr, Joe Chiu, and Dan Awai were most helpful. The State Historic Preservation Office, and its Chief Archaeologist Dr. Ross Cordy, provided support of various kinds including the assistance of its Maui field crew. Patti Conte, crew chief, along with Jim Hayden, Valerie Nagahara and Jenny O'Cleary were cheerful co-workers on the lantana-covered slopes with Berkeley students Kathy Kawelu and Greg Reuter. Volunteers John Holson and Cathy Davenport also augmented the field effort, and Douglas Yen joined us for a memorable two-day visit.

We owe special thanks to the members of Ka ʻOhana o Kahikinui, including Mo Moler, Donna and Walter Simpson, Don Smith, Russell Suzuki, Wayne and Laurie Ishikawa and their daughter Trina, and Mahealani Kaiʻaokamalie for welcoming us into their community and for providing boundless hospitality and support.

Dr. Mark Hall, Laboratory Assistant in the Archaeological Research Facility, was responsible for the digitizing and image analysis of aerial photographs, and assisted the project in other aspects of laboratory analysis. Thérèse Babineau kindly printed the photographs used in this article.

References

Chapman, P. S. and P. V. Kirch. 1979. *Archaeological excavations at seven sites, Southeast Maui, Hawaiian Islands.* Departmental Report Series 79-1. Honolulu: Department of Anthropology, B. P. Bishop Museum.

Commissioner of Public Lands, Territory of Hawaii. 1929. *Indices of awards made by the Board of Commissioners to quiet land titles in the Hawaiian Islands.* Honolulu: Territorial Office Building.

Dunmore, J., ed. 1994. *The journal of Jean-François de Galaup de la Pérouse 1785–1788.* Hakluyt Society, Second Series No. 179. London: The Hakluyt Society.

Erkelens, C. 1995. *Phase I archaeological investigation, cultural resources survey, Hawai'i Geothermal Project, Makawao and Hāna Districts, south shore of Maui, Hawai'i.* Prepared for Oak Ridge National Laboratory. Honolulu: International Archaeological Research Institute, Inc.

Green, R. C. 1967. Settlement patterns: Four case studies from Polynesia. In *Archaeology at the Eleventh Pacific Science Congress,* ed. W. G. Solheim, II, 101–132. Asian and Pacific Archaeology Series No. 1. Honolulu: Social Science Research Institute, University of Hawaii.

Green, R. C., ed. 1969. *Mākaha Valley Historical Project: Interim report No. 1.* Pacific Anthropological Records 4. Honolulu: Department of Anthropology, Bishop Museum.

Green, R. C. 1970. Settlement pattern archaeology in Polynesia. In *Studies in oceanic culture history,* ed. R. C. Green and M. Kelly, 13–32. Pacific Anthropological Records 11. Honolulu: Department of Anthropology, Bishop Museum.

Hammatt, H. H. and W. Folk. 1994. *Archaeological reconnaissance of an 8,300-Acre project area, Kahikinui, Maui, TMK 1-9-01:3.* Prepared for R. M. Towill Corporation. Honolulu: Cultural Surveys Hawaii.

Hiroa, T. R. (P. H. Buck).1945. *An introduction to Polynesian anthropology.* B. P. Bishop Museum Bulletin 187. Honolulu: Bishop Museum Press.

Hommon, R. J. 1970. Notes on a formal classification of Hawaiian archaeological features. *Hawaii State Archaeological Journal* 70:44–55. Honolulu: Department of Land and Natural Resources.

Kelly, M. 1983. *Na mala o Kona: Gardens of Kona. A history of land use in Kona, Hawai'i.* Departmental Report Series 83-2. Honolulu: Department of Anthropology, Bishop Museum.

Kirch, P. V. 1984. *The evolution of the Polynesian chiefdoms.* Cambridge: Cambridge University Press.

———. 1985. *Feathered gods and fishhooks: An introduction to Hawaiian archaeology and prehistory.* Honolulu: University of Hawaii Press.

———. 1994. *The wet and the dry: Irrigation and agricultural intensification in Polynesia.* Chicago: University of Chicago Press.

Kirch, P. V. and M. Kelly, eds. 1975. *Prehistory and ecology in a windward Hawaiian valley: Halawa Valley, Molokai.* Pacific Anthropological Records 24. Honolulu: Department of Anthropology, Bishop Museum.

Kolb, M. 1994. Monumentality and the rise of religious authority in pre-contact Hawai'i. *Current Anthropology* 35:521–547.

Ladefoged, T., G. F. Somers, and M. M. Lane-Hamasaki. 1987. *A settlement pattern analysis of a portion of Hawaii Volcanoes National Park.* Publications in Anthropology No. 44. Tucson: Western Archaeological and Conservation Center, National Park Service, U. S. Department of the Interior.

Macdonald, G. A. and A. T. Abbott. 1970. *Volcanoes in the sea: The geology of Hawaii.* Honolulu: University of Hawaii Press.

Matsuoka, J. K., D. P. McGregor, L. Minerbi, M. Kelly, and N. Barney-Campbell. n.d. *Native Hawaiian ethnographic study for the Hawai'i Geothermal Project proposed for Puna and southeast Maui.* Prepared for Oak Ridge Laboratory. Honolulu: CANDO.

Medeiros, A. C., Jr., L. L. Loope, and R. A. Holt. 1986. *Status of native flowering plant species on the south slope of Haleakalā, East Maui, Hawaii.* Technical Report 59. Honolulu: Cooperative National Park Resources Study Unit, University of Hawaii at Manoa.

Newman, T. S. 1970. *Hawaiian fishing and farming on the island of Hawaii,* A.D. *1778.* Honolulu: Division of State Parks, Department of Land and Natural Resources.

Pearson, R. J., ed. 1968. *Excavations at Lapakahi: Selected papers.* Hawaii State Archaeological Journal 69-2. Honolulu: Department of Land and Natural Resources.

Rosendahl, P. H. 1972. *Aboriginal agriculture and residence patterns in upland Lapakahi, Island of Hawaii.* Ph.D. diss., University of Hawaii at Manoa, Honolulu.

Rosendahl, P. H. 1994. Aboriginal Hawaiian structural remains and settlement patterns in the upland agricultural zone at Lapakahi, Island of Hawai'i. *Hawaiian Archaeology* 3:14–70.

Ruppé, R. J. 1966. The archaeological survey: A defense. *American Antiquity* 31:313–333.

Stearns, H. T. and G. A. Macdonald. 1942. *Geology and ground-water resources of the island of Maui, Hawaii.* Division of Hydrography Bulletin 7. Honolulu: Territory of Hawaii.

Tuggle, H. D. and P. B. Griffin, eds. 1973. *Lapakahi, Hawaii: Archaeological studies.* Asian and Pacific Archaeology Series 5. Honolulu: Social Science Research Institute, University of Hawaii.

U. S. Geological Survey. 1971. *Surface water supply of the United States 1960–65. Part 16. Hawaii and other Pacific areas.* Geological Survey Water-Supply Paper 1937. Washington D. C.: Government Printing Office.

Walker, W. 1931. Archaeology of Maui. Typescript on file, B.P. Bishop Museum Library, Honolulu.

Weisler, M. and P. V. Kirch. 1985. The structure of settlement space in a Polynesian chiefdom: Kawela, Moloka'i, Hawaiian Islands. *New Zealand Journal of Archaeology* 7:129–158.

How Does the Kumulipo Mean?

Tom Dye

State of Hawaii, Historic Preservation Division

When Queen Lili'uokalani's translation of the Kumulipo was published in 1889 it was called a "genealogical prayer chant" that described the creation of the world. Later, Pokini Robinson read it as "the conception, gestation, nurture, and achievement of a chief" (Perkins 1991a:14), a view that swayed Martha Beckwith, the Vassar College folklorist, who was the first to analyze the Kumulipo as a creation chant. Rubellite Johnson, the University of Hawaii professor, saw in it a Hawaiian understanding of biological evolution (Johnson 1985). Theodore Kelsey considered it "an intrinsic work of art among the greatest yet produced" (Perkins 1991a:24), and Leialoha Apo Perkins, editor of the recently established *Journal of Hawaiian and Pacific Folklore and Folklife Studies,* agrees with him that "the Kumulipo is a world classic" (Perkins 1990:18). She has dedicated the first three volumes of the journal to Kelsey and his lifelong investigators into the meaning of the poem.

Kelsey, who died at Honolulu in 1987 at the age of 96, published little and carried on his sixty year study of the Kumulipo outside of academia. His work was inspired by the ideas of the University of Hawaii Hawaiian language scholar Frederick "Kahapula" Beckley and sustained by the interest of many "Hawaiians well versed in their native tongue" (Kelsey 1991:143), especially Henry E. P. Kekahuna, whose interpretive maps of heiau ruins are well known to archaeologists. Kelsey saw his work with the Kumulipo as translating and interpreting a "cryptic form of poetry" with a "hidden esoteric sense" (Advertiser April 9, 1939). But unlike other translators and interpreters, who saw in the Kumulipo a story of the creation of the natural world, or a metaphor for the life of an individual, Kelsey believed that the Kumulipo reflected "a migration of warring clans to the archipelago and the need to formulate or reformulate rules by which [Hawaiians] could

understand whose rights lay where, how, and when and by what authority" (Perkins 1990:44).

The Kumulipo as social history is based on Kelsey's understanding of the poem's *kaona,* which Perkins (Perkins 1991a:1) describes as a group of phonics (or in some instances sonics) which is regularly employed under the same more or less metrical conditions to express a given essential idea. This system of "linked assonance" transmits meaning through the repetition of vowel sounds that denote different kin groups. Kelsey apparently concentrated on the interpretation of the vowels *a, e, o,* and *u,* but Perkins makes frequent reference to *i,* as well. Central to this understanding is the Kumulipo as oral presentation rather than written text. The poem's publication at the end of the last century marked its demise, not its birth, and signaled the end of its social use by *ali'i* "to confer validation to titular roles which encumbered rights and privileges of rank, status and class" (Perkins 1991a:6). The devices used by the poem to encode meaning are not those of the written word, but the spoken word, and belong to what Perkins calls a "bardic tradition," where chanters presented the poems to an audience of knowledgeable *ali'i,* whose views on Hawaiian social history were shaped by conquest, marriage, and alliance and were well known to the chanters. The *ali'i* undoubtedly found pleasure in the fact that only they could understand the meaning encoded in the cryptic poetic forms, a pleasure that was heightened by the chanter's clever use of rhythm and stress to highlight the code. All of this Kelsey understood implicitly, drawing on his own and his informants' deep knowledge of Hawaiian language to develop an interpretive understanding of the poem through application of the *kaona.*

Perkins, with a Ph.D. in folklore from the University of Pennsylvania, has spent more than sixteen years with Kelsey's voluminous notes on the Kumulipo working to make explicit what Kelsey was unable to formulate. Her labors have resulted in a long theoretical essay entitled "The rhythmic drive: . . . toward a mytho-poetic systemics of scansion," whose title, abbreviated here, only hints at the complexity of the oral compositions beneath the text. The bibliography includes books and articles in Hawaiian, English, French and German by philosophers, linguists, anthropologists, historians, folklorists, philologists, and interestingly, archaeologists. Perkins is clear about the central place of archaeology in the contextualization of myth, and she draws on archaeological sequences of change in settlement, population, and social stratification to bolster and enrich inferences drawn from application of the *kaona* to the poem. Petroglyphs on Lanai recorded by Emory are even interpreted as referring to allusions in the Kumulipo.

In 1929, very early in his study of the Kumulipo, Kelsey wrote in the Honolulu Advertiser that the "remarkably highly metaphorical literature of Hawaii's great ocean of native poetry is about as little known as the hieroglyphics of the Mayas . . . " (Perkins 1991a:11). Mayan hieroglyphs at that time were thought to be "the province of esoteric information, with little bearing on broader studies of ancient society" (Houston 1993:1), much as the Kumulipo is viewed by many Hawaiian historians today. The last thirty years have seen a remarkable advance in deciphering Maya glyphs, however, and Mayanists now regularly make use of glyphic evidence to study social and political history. Kelsey's *kaona* holds out the promise of being the key that unlocks the social and political history held in the Kumulipo and other poems. In Perkins' hands the *kaona* as "linked assonance" renders the Kumulipo a kind of template, capable of expressing many meanings, each of which entails its opposite. Used by one chiefly line to exalt itself, the poem in the hands of a conqueror could be used to celebrate the earlier line's demise. Against this shifting semantic ground Perkins culls what she believes is the true theme of the myth in the poem—"to survive, man must grow, and to grow, man must live in peace, and to live in peace, man must negotiate, and to negotiate, man must honour his fellow man" (Perkins 1991b:121).

Bibliography

Houston, S. D. 1993. *Hieroglyphs and history at Dos Pilas: Dynastic politics of the Classic Maya.* Austin: University of Texas Press.

Johnson, R. K., ed. 1985. *Kumulipo.* Honolulu: Topgallant.

Kelsey, T. 1991. Theodore Kelsey's acknowledgment of his Kumulipo informants. *Journal of Hawaiian and Pacific Folklore and Folklife Studies* 2, Pt. 2, Sec. A:143–46 ff.

Perkins, L. A. 1990. On Theodore Kelsey's Field Notes to the Kumulipo. *Journal of Hawaiian and Pacific Folklore and Folklife Studies* 1:1–53.

———. 1991a. On the Beckley, Kekahuna, and Kelsey interpretation of the Kumulipo: Kelsey translation and text, Ts. C1. *Journal of Hawaiian and Pacific Folklore and Folklife Studies* 2:1–27.

———. 1991b. The rhythmic drive: Toward a mytho-poetic systematics of scansion. *Journal of Hawaiian and Pacific Folklore and Folklife Studies* 2, Pts. 1–2 (Sec. A):43–126.

Editorial and subscription notices

Hawaiian Archaeology, founded in 1984, is published by the Society for Hawaiian Archaeology, a registered tax-exempt organization.

Address

Hawaiian Archaeology, Society for Hawaiian Archaeology, P. O. Box 23292, Honolulu, Hawai'i 96823-3292 is the address for all matters relating to the Society and to *Hawaiian Archaeology*.

Current subscriptions

Hawaiian Archaeology is published annually and distributed to members of the Society for Hawaiian Archaeology. Current dues are:

Professional—$26
Regular—$22
Associate—$18

Membership applications are available from the Secretary of the Society for Hawaiian Archaeology.

Notes for contributors

Articles on Hawaiian prehistory or archaeology, or that contribute to the advance of method and theory as these apply to Hawai'i, are considered for publication in *Hawaiian Archaeology*. Send three photocopies of the text and of illustrations or roughs to the Publications Committee of the Society for Hawaiian Archaeology. Preferred style is as you find it in this volume, and generally follows *The Chicago Manual of Style*, 13th or 14th Edition, for scientific and technical publications using the short (B) form for bibliographic citations. Authors of articles accepted for publication will be asked to submit a copy of the text on a diskette formatted for DOS and to provide camera-ready illustrations.

Conventions for radiocarbon dates

In citing radiocarbon dates, *Hawaiian Archaeology* uses the following conventions: B.P. (before 1950) CRA (conventional radiocarbon age) indicates a radiocarbon age that (i) uses 5568 as the ^{14}C half-life, (ii) was measured against the NBS oxalic acid standard, (iii) uses 1950 as the zero date for radiocarbon time, (iv) is normalized for $\partial^{13}C$, and (v) has not been corrected for reservoir effects; B.C./A.D. indicates a measurement that has been calibrated to calendar years.

Cover image

Detail. *A Young Woman of the Sandwich Islands,* 1779. Engraving by John Keyse Sherwin after a drawing by John Webber. Courtesy of Barbara Pope.