

AUSTRALIAN MUSEUM SCIENTIFIC PUBLICATIONS

Pietrusewsky, Michael, 1989. A study of skeletal and dental remains from Watom Island and comparisons with other Lapita people. *Records of the Australian Museum* 41(3): 235–292. [30 November 1989].

doi:10.3853/j.0067-1975.41.1989.145

ISSN 0067-1975

Published by the Australian Museum, Sydney

nature culture **discover**

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A Study of Skeletal and Dental Remains from Watom Island and Comparisons with Other Lapita People

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ABSTRACT. Human skeletal and dental remains from Watom Island, East New Britain Province, Papua New Guinea, dated circa 500 to 100 years BC and associated with the Lapita cultural complex are described. The remains, often poorly preserved and incomplete, include six adult male and two adult female skeletons. Morphometric features of the mandible include a broad short mandibular body, divergent ramus and the rocker jaw condition. The teeth, slightly to moderately worn, are small, caries free and exhibit periodontal disease. Males are tall (174 cm) and the long limb bones are typically gracile. Squatting facets and costo-clavicular sulci are common. Except for a few, mostly minor, healed bone fractures, there is little evidence of disease. Comparisons indicate that the people of Watom are, in some respects, similar to Polynesians and other Pacific populations by virtue of their tall statures, rocker jaws and shovel-shaped incisors but they further exhibit striking morphological differences, such as small teeth, gracile long limb bones and broad short mandibles not seen in other Pacific populations. Multivariate analyses of mandibular measurements reiterate this unique Watom mandibular morphology and further separate the Watom and Lapita samples from Polynesian samples. Broader multivariate comparisons place Polynesians with South-east Asian and East Asian groups well differentiated from Melanesian samples lending support to the view that Polynesians are not of Melanesian origin. A weaker connection between Lapita Watom people and mandibular samples from eastern Melanesia and Polynesia is further implied in these results. Finally, this study demonstrates that until larger and earlier dated Lapita skeletal remains become available, the biological relationships and origins of the Watom and Lapita people remain elusive.

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Human remains associated with the Lapita cultural complex (ca. 3,600 to 2,500 YBP), are extremely rare. Lapita skeletal remains are a prerequisite for understanding the biological origins of the Austronesian-speaking populations of eastern Melanesia, Polynesia and central Micronesia. Site SAC (Site 8) in Rakival Village on Watom Island, East New Britain Province, Papua New Guinea, although relatively late in the Lapita sequence (ca. 500 to 100 BC), has provided more human remains than all other known Lapita sites combined. Thus far the remains of at least eight individuals are represented in the Watom Island sample.

The following account summarises the results of an osteological-odontological study of the Watom Lapita remains. The initial examination of these remains was made by Pietrusewsky over a six week period in mid-1987 at the Department of Anatomy, University of Otago in Dunedin, New Zealand. The sections include methods and material, individual descriptions of the burials, a summary of the metric and non-metric observations recorded in the skull, teeth, and infracranial remains, evidence of disease and the general state of health of the Watom individuals. Univariate and multivariate comparisons with other Lapita remains and more modern populations from the Pacific and surrounding regions conclude the report.

Appendix A includes all plates and Appendix B includes all tables referred to in the text.

Material and Methods

Watom burials. In 1966, Jim Specht excavated three human skeletons from Trench I (later renamed Rectangle I) in Locality SAC (originally coded as Site 8 or FAC) at the Reber-Rakival site on Watom Island (Specht, 1968). In 1985, as part of the Lapita Homeland Project, Roger Green and Dimitri Anson excavated five additional skeletons from Rectangles I, II and IV at the same site. All burials, which are from the basal grey sand midden layer, are dated circa 500 to 100 BC, probably toward the latter end of that range (Green & Anson, 1987). The burials, which occur mostly in pits, were in extended and flexed positions. Most of the skeletons were missing their skulls. Because of their repeated exposure to the high tide water level, the remains were found to be in a generally deplorable condition at the time of their excavation (Green, personal communication).

Laboratory procedures. All skeletal remains from Watom, including those excavated by Specht in 1966, were examined by Dr Philip Houghton of the University of

Otago prior to the present study. While most of the material had been unpacked before the present study was initiated, there were some exceptions. For example, a small box associated with Burial 2 which bore the inscription "metacarpals, metatarsals and phalanges", appeared not to have been opened. Each bone was found to be individually wrapped in tissue (waxed) paper. Careful inspection of this material, resulted in identification of not only metapodial and phalanges but the distal ends of the right fibula and ulna. Further, there were a great many smaller bags containing isolated teeth and fragments of bone and other non-human remains (i.e. sand, shell, coral, cultural and faunal remains) not directly associated with any of the major burials. This latter (miscellaneous) material, which was boxed separately by the excavators, had received little attention prior to the present study.

While some reconstruction (mending of the broken mandibles and some of the other limb bones) had been attempted previously, a large portion of the remains had not been sorted or cleaned. Before any data were recorded, the remains were first washed (using cold water) to remove the dirt and encrustations which covered most of this material. Mechanical means were used to remove the latter deposits. Sorting and identification of the remains were then initiated. Using a water soluble glue, some of the broken bones were mended. The miscellaneous remains were subjected to the same treatment. Using the provenance information written on the outside of the bags containing the scattered remains and the excavator's fieldnotes and excavation grid, much of the miscellaneous material could be assigned to one of the major burials. The material which was added to the major burials is documented in Appendix A which further contains a complete inventory of all miscellaneous remains.

Once the remains had been cleaned, mended and identified, an inventory of the completeness of each burial was made by coloring in the appropriate areas of standard skull and burial register forms used at the University of Hawaii. These and other forms used in the present study are available, upon request, from the author. Metric and non-metric observations were recorded in all skeletal and dental remains using additional standard forms. These completed forms are kept on file in the Department of Anthropology at the University of Hawaii, Honolulu.

Other Lapita remains or remains contemporaneous with Lapita. Other known Lapita skeletal remains, or those which are contemporaneous with the Lapita cultural complex, used in the present study for comparison with the Watom material include:

1. *Lakeba, Fiji.* The fragmentary remains of at least two

individuals from Lakeba, a Lapita site in the Lau Group, Fijian Islands, were excavated by Simon Best (1977). The site's initial occupation dates to the early part of the first millennium BC and the burials are from the middle part of that interval. This material was examined and described by Houghton before it was returned to Lakeba for reburial (see Houghton, this volume). Observations used in the present study were recorded by the author in 1983 on two mandibles [one is a cast (Lakeba 1) and the other is an original specimen (Lakeba 2)].

2. *Natunuku, Fiji*. This is a partially complete skeleton of an adult male excavated by Elizabeth Shaw (1967, 1975) at Natunuku VL1/1, an early Lapita site on Viti Levu of the Fijian Islands which has a date of $1,590 \pm 100$ yr BC, although others (Green, personal communication; Spriggs, personal communication) argue that, while early in the Fijian Lapita sequence, the burial is probably not as early as the 1,500 BC date often assigned to it. Previous attention has focused almost exclusively on the mandible, the most complete bone in these remains (Pietrusewsky, 1985a, 1985b). A more complete description of the Natunuku skeleton appears in this volume.

3. *Tonga*. Skeletal remains, originally designated Burial AK by Poulsen (1987:21), are from Burial Pit AF of Trench III at site To.1, a Lapita site located in Pea township, Tongatapu, Tonga. While Spennemann (1987) has concluded that at least three individuals are represented, this investigator, after examining the same material in 1987 at the Department of Anatomy, University of Otago, agrees with Houghton's assessment that the mandible belongs to the main burial. Other intrusive remains (e.g., a left third cuneiform, fragment of proximal end of a left ulna and distal third of a left humerus) represent at least one additional individual (see Houghton, this volume). Plates 29 and 30 exhibit some of the bones from this burial.

4. *Manus*. A mandible fragment excavated by W. Ambrose in 1981 from a site in Baun Village on Lou Island, Manus Province, Papua New Guinea. The dates for the site have been recently revised to circa 2,100 YBP (Ambrose, 1988a, 1988b). While the pottery and other aspects of the archaeological record found in association with the Manus mandible are not Lapita, the mandible is contemporaneous with the latest phases of the Lapita culture further east. The mandible was examined by the author during a brief visit to the Australian National University in Canberra in 1987.

Age determination. Standard osteological and forensic criteria were used to determine the age-at-death (Anderson, 1969; Bass, 1988; Brothwell, 1981; El-Najjar & McWilliams 1978; Krogman & Iscan, 1986; Stewart, 1979; Ubelaker, 1984). Among the methods used were epiphyseal union, tooth calcification and eruption, metamorphosis of the symphysis pubic bone (McKern & Stewart, 1957; Gilbert & McKern, 1973) and cranial suture closure. Given the fragmentary nature of the Watom remains, determining the exact age for adults was generally compromised. Degenerative changes in the limb bones and vertebral column and tooth wear provide more general impressions

of age, which are used to augment estimates based on the more reliable methods of age determination.

Sex determination. The morphological appearance of the pelvis (e.g. sciatic notch, ventral arc, subpubic angle, pelvic shape, etc.), cranial indicators and limb bone diameters were found to be the best criteria for determining the sex of adults.

Measurements. All measurements, recorded to the nearest millimetre, follow standard osteometric techniques (Martin, 1957; Howells, 1973). Swiss-made sliding, spreading and small coordinate calipers, a mandibulometer and an osteometric board were used to record these measurements. Tooth measurements (recorded to the nearest tenth of a millimetre) were made using a dial Helios caliper fitted with pointed tips.

Following standard convention, measurements were recorded on the left side in the skull. If the left side was not present, the same measurement was recorded on the opposite side. Measurements were recorded on both sides in the infracranial skeleton.

Stature estimation. Estimations of stature are based on formulae of Trotter (1970) and Houghton *et al.* (1975). The latter have a tendency to give slightly taller stature estimates. In a few instances, when the limb bones were not complete, the maximum lengths were estimated from one of the several segment measurements using the method described by Steele (1970).

Non-metric observations. Observations of non-measurable morphological features (e.g. metopic suture, squatting facets, rocker jaw, etc.) follow the work of several investigators (e.g. Pietrusewsky, 1969, 1974, 1976; Brothwell, 1981; El-Najjar & McWilliams, 1978; Saunders, 1978).

Pathology. Observations of diseased bone are presented in the individual burial descriptions found in Table 1. Observations of dental pathology, including tooth loss, periodontal disease, caries, enamel hypoplasia and dental wear are summarised in the section on teeth. Degenerative changes in the infracranial skeleton and vertebral column were systematically scored for each articular surface using the scale: absent (0), slight (+), medium (++) and marked (+++) depicting the degree of osteoarthritic lipping. All observations of pathology were restricted to the macroscopic level of inspection.

Statistical analysis. All data were analysed using the IBM 3081 mainframe computer at the University of Hawaii-Manoa computing center. Various statistical packages, e.g. SAS-Statistical Analysis System, BMDP (Dixon & Brown, 1979) and other specially written computer programs were utilised in analysing the data. Both univariate, (descriptive statistics) and multivariate procedures (e.g. Mahalanobis' Generalized Distance, stepwise discriminant function analysis and regression analysis) were employed. All data are currently stored on magnetic tapes at the University of Hawaii.

Burials

The Watom burials exhibit considerable postmortem damage as a result of natural disturbances and exposure to periodic high tide water levels. General preservation of these remains ranges from poor to fair. Burial 6 is the best preserved skeleton. Although the cranium of the latter is mostly missing and fragmentary, the rest of the skeleton is relatively complete and includes several intact upper limb bones. With the exception of hand and foot bones, the bones of the remaining Watom burials are frequently incomplete.

Six of the eight Watom burials are missing skulls. Two of the former burials possess upper cervical vertebrae suggesting that the heads had not been removed prior to or around the time of burial and that natural disturbances probably account for their absence. The crania of Watom Burial 3 and 6 are very incomplete and poorly preserved. Four mandibles, none perfectly preserved, were identified in these remains. Two of the latter belong to major burials and two (M1 and M2) were identified in the miscellaneous remains from the site.

Two females are represented in the remains from Watom, one between 18 and 20 years of age and the second approximately 30 years of age at time-of-death. The remaining skeletons are adult males who range in age between 30 and 35 years. There are no subadults or individuals of old age.

Table 1 summarises some of the salient features recorded for each burial. The features include the burial's provenance, age-at-death, sex, stature, completeness, preservation, pathology/anomalies and other comments.

Skull

Only two skeletons are represented by cranial remains, Burials 3 and 6 (Plates 1-11). For each, the mandible is the best preserved bone. The warped cranial vault remains from Burial 6 include the left temporal and a portion of the parietal bone. Other identifiable vault bones from this burial include two substantially complete zygoma bones and the left maxilla. The rest of the cranium is represented by numerous vault fragments. Large areas of the face and base of the skull are missing. Reconstruction of these remains is limited.

The skull of Burial 3 is more complete but not intact. The frontal, right (warped) parietal and right zygoma are substantially complete and disarticulated. Most of the left parietal, both temporals and the occipital bone are further preserved. The cranial vault bones form a calcified mass which prevents reconstruction. Alveolar prognathism is observed in the remains of this individual.

Measurements recorded in the two crania (Table 2) and four mandibles, all adult male, are presented in Tables 2 and 3 respectively. A summary of the means and standard deviations of these mandibular measurements and indices are presented in Table 4. This table further presents measurements recorded in the Lakeba and Natunuku

mandibles.

Two conspicuous features observed in the Watom mandibles are the short body lengths and wide ascending rami. The mandibular index, which measures the length of the mandible relative to the breadth, confirms this visual appraisal. The ramus index (N=3) further indicates the ramus has a very broad shape. The uniqueness of the Watom mandibles will be addressed later. A summary of the non-metric variation recorded in the Watom and other Lapita-associated crania and mandibles are presented in Tables 5 and 6.

The Watom mandibles uniformly exhibit single mental and mandibular foramina and further lack mandibular tori and bridging of the mylo-hyoid groove. Complete or partial rocker jaw was recorded in three of the four mandibles from Watom. The shape of the chin is pointed medially and is frequently associated with a slight inferior angulation at the symphysis menti in two of the four Watom mandibles examined.

Teeth

Tooth measurements. Mesial-distal and buccal-lingual crown diameters and cross-sectional areas were recorded in the permanent teeth of three individuals from Watom. Summary statistics of these measurements recorded in the Watom teeth and several other Lapita samples are given in Table 7. Using the mean cross-sectional areas for each dental tooth category (sexes and sides combined), a tooth summary figure of 1140 was calculated for the Watom sample. While sample size is small (N ranges from 2 to 4), this figure confirms the general impression that the Watom teeth are small. Comparisons of the Watom teeth with Pacific and Asiatic dentitions will be made later.

Non-metric dental features. A record of the original non-metric observations, including pathology, recorded in the Watom dentitions was made. Summaries of this information, along with the data recorded in other Lapita teeth, are presented in Tables 8 through 11.

The maxillary incisors typically exhibit slight shovelling. Mandibular incisors are almost never observed to be shovelled in these remains. Examples of peg-shaped teeth, enamel extension and Carabelli's cusp are not observed in the Watom teeth. A protostylid cusp, an accessory cusp found in mandibular molars, is observed in a single tooth. The "+4" configuration is the most common cusp pattern in the mandibular molars from Watom.

Dental pathology. The incidence of pre-mortem and post-mortem tooth loss in Watom and other Lapita teeth is presented in Table 9. A single mandible (Watom 3) accounts for the majority of pre-mortem tooth loss observed in the Watom remains. Tooth loss in this mandible is restricted to the incisor and canine teeth.

The frequency of periodontal disease in Watom and other Lapita-associated dental remains is summarised in

Table 10. The majority of the Watom teeth exhibit calculus deposits and resorption of the alveolus bone suggestive of periodontal disease. Table 11 records the frequency of occurrence of other kinds of dental pathology recorded in the Watom and Lapita-associated teeth. Enamel hypoplasia is rarely observed in the dental remains from Watom. No examples of dental caries or abscessing are observed. Slight (affecting the enamel only) to moderate (dentin exposed) levels of attrition are observed in the Watom teeth. Some of the teeth of Watom Burial 6 are discoloured; the cause of this discolouration is indeterminate.

Infracranial Skeleton

The descriptive statistics for measurements recorded in the adult infracranial skeletons from Watom are set out in Tables 12. A summary of estimated stature and indices derived from the mean measurements are presented in Tables 13 and 14.

Stature estimates for six male skeletons range from 170 cm (5'7") to 180 cm (5'11"). Estimates of stature for the two females are 155 cm (5'1") and 164 cm (5'5"), respectively. According to the humeral diaphyseal index, the Watom male humeri are not flat. The forearm bones are long relative to the lengths of the upper arm bones. The shapes of the upper femur shafts in Watom males border on flattening (platymeria) but the mean value for this index indicates they are more rounded. The mid-shafts of the femora have medium to strong pilaster (well-marked linea aspera) development. The proximal tibial shafts approach eurycnemic (triangular) shapes.

A summary of the non-metric variation observed in the Watom and Tongan (Burial AK) infracranial skeletons is given in Table 15.

A costo-clavicular sulcus, located at the site where this ligament inserts on the inferior surface of the clavicle, is well developed in five of the six sides examined. Houghton (1980) attributes the latter feature to canoe paddling among Polynesians. A supraclavicular foramen is observed in two clavicles. A septal aperture, or perforation of the olecranon and coronoid fossae in the distal humerus, is observed in a single bone. Deep preauricular pitting (groove of pregnancy), is observed in the left innominate bone of Burial 1. An imprint of a ligament, in the same region, is observed in Watom Burial 3, a male. A Fossa of Allen, or cervical depression near the anterior superior margin of the femoral neck close to the head, is observed in a single femur. The fovea capitis, the site of attachment of the ligament for the head of the femur, is oval in shape in three of the five bones examined and round in shape in the remaining two specimens. A small depression (here called a facet) in the supero-lateral angle of the patella is present in ten of the twelve bones examined. No examples of Vastus notch, a larger indentation in the same region of the patella, are observed in the Watom remains. Spurring of the anterior surface of the patella is relatively common. Both tibial and talar squatting facets are observed in these remains. The anterior calcaneal facet is discrete in five of

the nine bones examined. The peroneal tubercle, located on the anterior lateral surface of the calcaneus, is scored as present in two of the five bones examined.

A summary of non-metric variation recorded in the vertebral columns from Watom Island and Burial AK from Tonga are summarised in the Table 16. No unusual variation was observed in any of the vertebrae from Watom. No cases of spina bifida or spondylolysis were observed.

Photographic plates of some of the long limb bones from the Watom burials are shown in Plates 12–28.

Palaeopathology

Dental pathology is summarised in the section on teeth. In this section, a summary of osteoarthritis or degenerative changes in the articular surfaces of the infracranial skeleton are presented along with any other kinds of pathology observed in these remains.

Osteoarthritis. Observations on osteoarthritis in the limb and vertebral skeletons were made in the eight Watom burials. A summary of osteoarthritis in the appendicular skeleton is presented in Table 17. There is very little arthritic lipping in the Watom remains; the level of involvement generally does not exceed minimal levels of severity. Osteophytosis and degenerative changes in the vertebral column are of equally low occurrence.

Other pathology. Other examples of pathological bone in the Watom remains are relatively uncommon. Brief comments on the pathology observed in each of the eight burials are made in Table 1. Some of the pathology is summarised here.

Possible trauma and periostitis. The left fifth metacarpal of Burial 2, a young female aged between 18 and 20 years, exhibits slight callus formation about mid-shaft suggestive of a healed fracture (Plate 14). The fracture is well healed indicating the trauma had occurred at an early age. The proximal phalanx for the left second metacarpal from Watom Burial 3, a male aged 30 to 40 years, exhibits a possible healed fracture and periostitis at the proximal end (Plate 15). No x-rays were available to confirm these interpretations.

The proximal end of the left femur of Burial 6, a male whose age has been estimated to be about 30 to 35 years, is pathological (Plate 27). The entire subtrochanteric region is enlarged and the greater trochanter was probably lost postmortem. The rest of the femur is not involved. Differential diagnosis includes periostitis, or inflammation of the periosteum due to infection or traumatic injury, possibly a healed fracture, in the subtrochanteric region. Drainage cloacae are not present. The left femur is approximately 14 mm shorter than the right. Radiographs were not available.

Other. Enlarged nutrient foramina were observed in at least two metatarsal bones of two different burials (Plate 28).

Partial sacral hiatus was observed in the sacral fragment belonging to the remains of Burial 5. The right fibula of this same individual is unusually long and exhibits localised swelling in the region where the peroneus brevis attaches. The soleal line in the left tibia of Burial 8 is especially well developed. The latter, while incomplete, appears to be longer than the right tibia. Some examples of dental pathology observed in the Watom remains are presented in Plates 2–6.

Comparisons

In this section I attempt to elucidate the biological relationships of the Watom Lapita remains through univariate and multivariate comparisons with other Oceanic skeletal samples including some of the extant Lapita skeletal samples. Some of the information recorded in other Lapita remains has been presented in the tables summarising the observations recorded in the Watom remains. New tables, containing information for other Pacific and Asiatic samples, are introduced in this section. Given the limited number of Lapita skeletons being compared, the conclusions reached must remain tentative.

Univariate comparisons. Comparing the mandibular measurements and indices (Table 4) recorded in the Watom and Lapita samples reveals some similarities. For example, the index of robustness, which measures the thickness of the mandibular body, is about the same in the Watom and Lakeba specimens. The shape of the ramus, as expressed by the ramus index, is similar for the Watom and Tongan (Burial AK) specimens. The mostly edentulous condition of the Natunuku mandible explains the relatively low mandibular height measurements recorded in this specimens. Comparing the Watom indices with other Pacific groups (Table 18) emphasises the distinctiveness of the Watom mandibles. The relatively broad mandibular shape, divergent and broad rami, immediately apparent when viewing the material for the first time, are not found in any of the Pacific and Asiatic (including Lapita) mandible series presented in Table 18.

A more uniform morphological picture emerges when the non-metric characteristics of the Watom and Lapita mandibles (Table 6) are assessed. Although observations are restricted, none of the mandibles possess a mylo-hyoid bridge. Multiple mental and mandibular foramina are never observed. These features, however, are relatively rare in most Pacific mandibles. Two of the Watom mandibles are classified as 'rocker jaws'. One additional Watom mandible and all remaining Lapita mandibles are classified as partial 'rockers' while a fourth Watom mandible is a non-rocker. Broader comparisons (Table 19) suggest the rate of occurrence of rocker jaw in the Lapita mandibles (including Watom) is intermediate between the Polynesian and Melanesian samples. In these comparisons, any expression of rocker jaw, full or partial, is recorded as present. One of the highest rates of occurrence for rocker jaw (and the majority are partial rockers) is recorded in the

Papuan sample which consists largely of skulls from the Purari Delta, Gulf Province, Papua New Guinea.

Measurements and cross-sectional areas for Watom and Lapita teeth were presented in Table 7. Comparable, but incomplete, data are available for the Watom, Burial AK (Tonga), Natunuku and Manus specimens. The teeth of Burial AK are larger than those from Watom but this is not unexpected since modern Tongans have the largest teeth among Polynesians (Brace & Hinton, 1981). The Watom teeth, as measured by the tooth summary figure, are the smallest of any of the samples listed in Table 20. Other small toothed samples include the Chinese, Chatham Islanders, Borneo, Hawaii and Japan.

Non-metric dental variation recorded in the Lapita samples is given in Table 8. Peg-shaped teeth, enamel extensions and protostylid cusps are rare. Dental pathology is given in Tables 9 through 11. The occurrence of periodontal disease is about the same in the Watom and Tongan (Burial AK) Lapita samples. Caries are remarkably absent in the Watom teeth while twelve of the fourteen teeth in the Tongan specimen are carious.

Comparing infracranial indices for the Watom and Lapita samples (Table 14) suggests the shapes of the Watom tibial and femoral shafts are significantly different. The *linea aspera* in the Watom femora are not as well developed as those in the Natunuku and the Tongan femora nor is the upper femoral shaft in the Watom remains as flattened as it is in the Fijian and Tongan (Burial AK) specimens. Similarly, the shape of the tibial shaft at the level of the nutrient foramen in the Watom material is not as flat as it is in the Natunuku and Tongan (Burial AK) specimens. Assembling more comparative data (Table 21) indicates that the shapes of the lower limb bone shafts from Watom are most like those from prehistoric Tonga and Nebira. The latter is a site about 16 km inland from the coast near Port Moresby, Central Province, Papua New Guinea. The slenderness of the Watom limb bones is substantiated by the low value it receives for the femur robusticity index. Except for Fiji and Nebira, there are no additional data for Melanesian populations.

Examining stature, Polynesians are on average taller (170 cm) than Melanesians (160–165 cm). The estimates of stature for the Watom males (174 cm) are similar to Polynesians. However, the Tolai of the north-eastern Gazelle Peninsula of New Britain are as tall as the Watom people according to measurements made by von Luschan (1897) (and see Howells, 1970:210, 1973:164).

Although comparative data are generally lacking, the presence of costo-clavicular sulci, oval-shaped fovea capitis in the femoral heads and squatting facets in the Watom remains are consistent with the general morphological pattern seen in Pacific populations.

To summarise the univariate comparisons, the remains of Watom and Lapita people show similarities and differences when compared with other Pacific populations. The similarities with Pacific populations, especially Polynesians, include tall stature, presence of rocker jaw, shovel-shaped incisors, costo-clavicular sulci, oval-shaped fovea capitis and squatting facets. Evidence for periodontal disease and the lack of dental caries further coincide with a

dental pattern generally characteristic of Pacific populations. It should be emphasised, however, that none of these features are exclusive to Polynesians but are generally typical of most Pacific populations.

Differences include mandibles (especially from Watom) characterised as possessing broad divergent rami and short mandibular bodies. This latter combination is generally not seen in the mandibles of Pacific and Asiatic groups. The small tooth crown diameters and gracile lower limb bones observed in the Watom material are further without parallel among the inhabitants of the Pacific.

In conclusion, these comparisons, based on small samples, provide little in the way of definite conclusions regarding the biological relationships of Watom and Lapita human remains and other Pacific groups.

Multivariate comparisons. Because the conclusions reached regarding biological relatedness based on univariate statistics are indefinite, multivariate methods are next considered. Multivariate statistical procedures provide researchers with some of the most objective means now available for describing and quantifying biological relationships and patterns of intergroup variation. For a discussion of the meaning and some of the limitations of these methods, the reader is directed to Howells (1969, 1972, 1973), Corruccini (1975), Kowalski (1972), van Vark (1976) and van Vark & Howells (1984).

Two multivariate procedures, stepwise discriminant function analysis and Mahalanobis Generalized Distance (Mahalanobis, 1936) are applied to measurements recorded in Lapita mandibles, including those from Watom, and more modern Pacific samples. The mandible is the most numerous and complete bone present in these remains and hence its selection for multivariate comparisons. The computer program BMDP-7M was used to do the stepwise discriminant function analysis (Dixon & Brown, 1979). Tree diagrams were constructed applying the unweighted pair-group clustering technique.

Two separate analyses are made; one uses seven samples and 22 mandibular measurements and the another uses eight samples and four mandibular measurements. The means and standard deviations of the 22 mandibular measurements are given in Table 22. With the exception of the Lapita sample, these data are the same as those used in Pietruszewsky (1985b). The Lapita sample in the present study includes measurements recorded in three Watom mandibles and individual specimens from Tonga, Manus, Lakeba and Natunuku.

Missing measurements for the Lapita mandibles were replaced by mean scores calculated for the entire sample. Missing measurements for individual specimens in each of the remaining six samples were replaced by regressed values generated for each group by the stepwise regression program, PAM (Dixon & Brown, 1979). The means and standard deviations for the four measurements used in the second analysis are presented in Table 28.

Analysis I (seven samples, 22 measurements). *Stepwise discriminant analysis.* A ranking of the 22 measurements for seven male samples, according to the

F-values received in the final step of discriminant function analysis, is set out in Table 23. Mandibular length, mid-condylar width, symphysis height, bicondylar breadth and the width of the mandibular body at the mental foramen rank high in this analysis.

Eigenvalues and the percentage of dispersion for each of the six canonical variables are presented in the next table (Table 24). The first three functions account for nearly 80 percent of the total variance.

Canonical coefficients, arranged in decreasing order, for the first two functions are presented in Table 25. Bicondylar width, length of the mandible, ramus breadth and symphyseal height of the mandibular body are important discriminators in the first function.

The assignment values achieved at the end of the stepping process are arranged in Table 26. The percentage of correct classifications is very high. One Maori and one Tongan specimen each are misclassified as Northern Marianas. One of the Wairau Bar mandibles is misclassified as a New Zealand Maori. Fig. 1 is a plot of seven group centroids on the first two functions. The Lapita centroid falls outside the loose constellation which forms between the Polynesian and Micronesian samples. New Zealand and Chatham Islands are set off from the remaining groups.

Generalised distance. Mahalanobis' Generalised Distance is applied to six measurements which are found to produce the greatest discrimination in the previous analysis. The distances are set out in Table 27. A cluster analysis of the distances is shown in Fig. 2. The Lapita sample is the last to join the grouping after all the Polynesian and Micronesian samples have clustered. New Zealand (Maori) and Chatham Islands (Mori) form a tight cluster to which Namu is attracted. Tonga, Northern Marianas and Wairau Bar form a second major cluster.

In summary, this analysis, based on the largest number of mandibular measurements available for analysis, fails to place Lapita with prehistoric or more modern Polynesian or Micronesian (Chamorro) samples. The analysis does distinguish, however, a recognisable Lapita grouping. Mandibular length, bicondylar width and symphyseal height account for most of the differences produced.

Analysis II (eight samples, four measurements).

In this analysis the same multivariate procedures are applied to a more diverse sampling of mandibles representing populations from the Pacific and the Asiatic mainland. The set of measurements is reduced to four, the largest subset available for the groups sampled. Table 35 gives the means and standard deviations for the four measurements for each group. Smaller samples have been consolidated to form the groups presented. Group membership is explained at the bottom of Table 28. Some of these data have been used in previous investigations of the Lapita remains from Natunuku while others are being presented for the first time.

Stepwise discriminant function analysis. A ranking of the four measurements according to the F-values received in the final step of discriminant function analysis is presented in Table 29. The breadth of the ramus is the most important

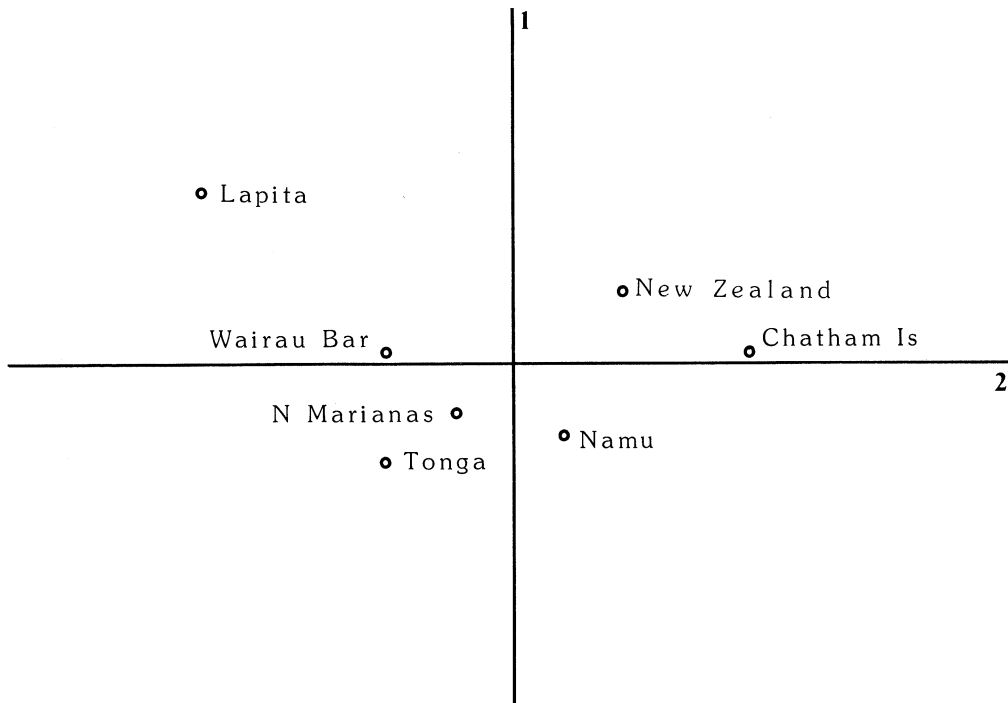


Fig.1. Plot of 7 male centroids on the first two discriminant functions.

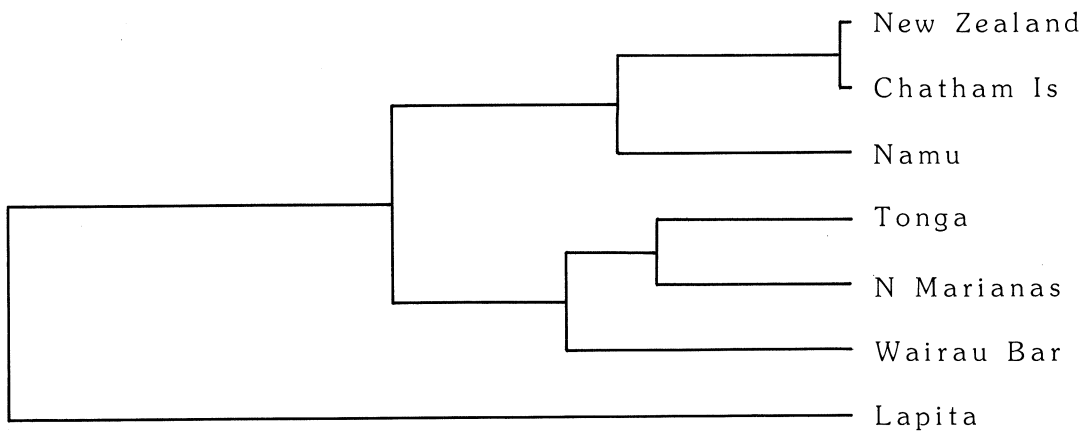


Fig.2. Diagram of relationship based on a cluster analysis of d-squared results based on 6 mandibular measurements.

variable and accounts for much of the discrimination produced. Eigenvalues and the percentage of dispersion are given in Table 30. The first two functions are responsible for nearly 90 percent of the total variance. Canonical coefficients for the first two functions (Table 31), arranged in decreasing magnitude, further indicate ramus breadth and symphysis height are the two most important discriminators. A summary of the classification results achieved at the end of the stepping process are given in Table 32. Generally, these classification results are poor. The highest number of correct classifications are those obtained by the Lapita sample.

Fig. 3 is a plot of group centroids on the first two functions. The Lapita and eastern Melanesian centroids

form a cluster while Polynesian, South-east Asian and East Asian centroids form a separate cluster. The Papuan and Bismarck Archipelago centroids occupy peripheral positions in the diagram. Plots of individual Lapita cases (not shown) indicate the greatest overlap is between the three Watom specimens and eastern Melanesia and secondarily with Polynesian cases. The Manus and Tongan (Burial AK) specimens follow a similar pattern of association. This program further calculates Mahalanobis' d-squared and the posterior probability values for each case after the final step of the discriminant analysis, and indicates on the basis of these scores any incorrect classifications. One of the Watom mandibles (Watom 3), for example, is misclassified as a Polynesian and Watom 6 is incorrectly classified as an

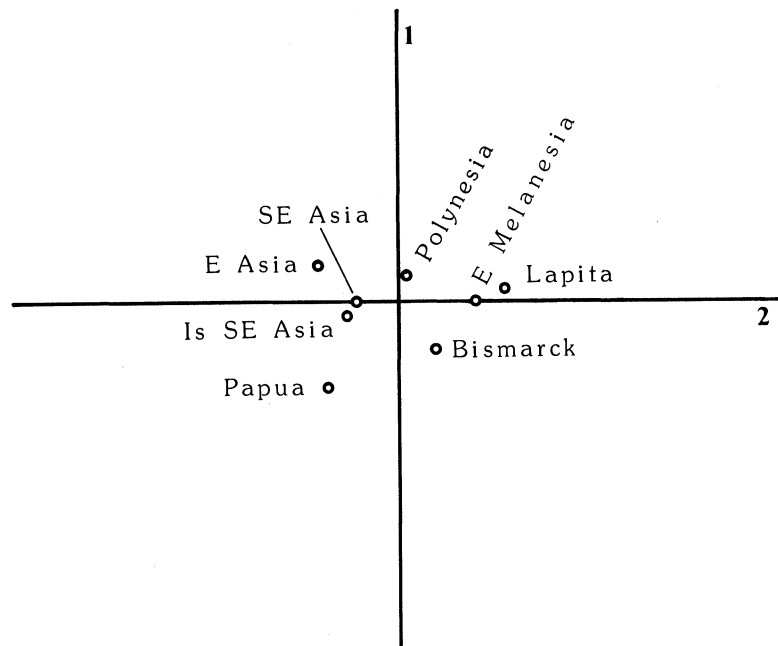


Fig.3. Plot of 8 group centroids on the first two discriminant functions.

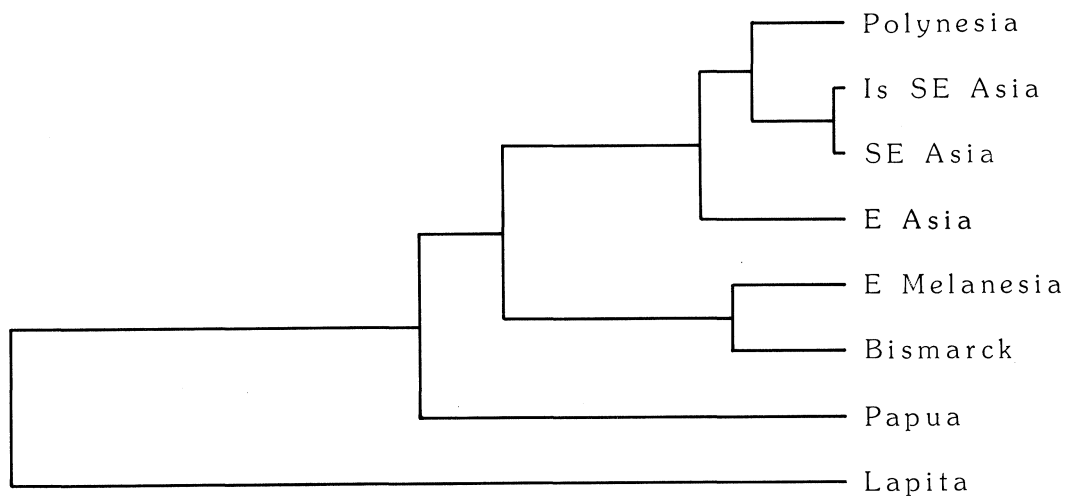


Fig.4. Diagram of relationship based on a cluster analysis of d-squared results based on 4 mandibular measurements.

eastern Melanesian.

Generalised distance. The results of applying Mahalanobis' Generalised Distance to four mandibular measurements recorded in eight male samples are presented in Table 33. The greatest distances are those between Lapita and all other groups. Fig. 4 is the diagram of relationship which results from a cluster analysis of the d-squared results. Polynesian, two South-east Asian and an East Asian sample form a cluster separate from one which includes the eastern Melanesian and Bismarck Archipelago samples. Papua and Lapita, in that order, connect after the latter two groups cluster. Inspection of the original d-squared values in Table 33 suggests that while

Lapita is generally far removed from all groups, it is relatively closest to the eastern Melanesian sample followed by the Polynesian and Bismarck samples. In the cluster analysis, however, these associations are no longer evident due to the very close connection which forms between the remaining groups.

This second multivariate analysis reiterates the distinctiveness of the Lapita mandibles and groups Polynesians with South-east Asian and East Asian samples. Plots of the group centroids on the first and second functions suggests a weak association between Lapita, eastern Melanesian and Polynesian means. Ramus breadth and the height of the symphysis are responsible for most of

the discrimination produced.

While limited to a few measurements recorded in mandibles, the results of the present multivariate analysis reinforce the isolation of the Lapita mandibles suggested in the univariate analyses. The multivariate analyses further hint at an eastern Melanesian (and possibly Polynesian) connection. Ramus breadth and symphyseal height emerge as the most important discriminators.

Summary and Conclusions

Eight adult (six male and two female) individuals are represented in the skeletal remains from Watom Island. With the exception of a single young (18 to 20 years of age) female, all individuals died between approximately 30 and 35 years of age. None of the major burials are subadults. The remains are in a generally poor state of preservation with only a few intact long limb bones represented. Four mandibles, of varying states of completeness, are further identified in these remains. Six of the eight major burials have no cranial remains. An inventory of miscellaneous human remains found at the site, some of which could be assigned to the major burials, is further made.

Measurements and non-metric observations recorded in all skeletal and dental remains from the Watom site are summarised by anatomical region. The mandibles are typically broad and short. Broad divergent ascending rami are further characteristic of the mandibles. With one exception, all the mandibles are classified as rocker jaws. The Watom teeth are unusually small and the incisors are slightly shovelled. While the teeth are generally caries free, there is evidence for periodontal disease and slight to moderate dental wear.

Stature estimates for the Watom male specimens fall into the tall category (174 cm). The long limb bones are typically long and gracile. Costo-clavicular sulci, oval-shaped fovea capitis and squatting facets are further common in the remains from Watom.

There is little or no osteoarthritis or osteophytosis in the Watom remains. Possible healed fractures are observed in hand and finger bones of two individuals. The proximal end of one femur exhibits periostitis, possibly the result of a traumatic (healed fracture) injury.

Limited univariate comparisons indicate morphological similarities (e.g. rocker jaw, tall stature, costo-clavicular sulci etc.) between the Watom and Lapita people and other inhabitants of the Pacific and Polynesia but further reveal a number of biological differences such as small teeth, slender lower long limb bones and short broad mandibles which are generally not found in Pacific Islanders. Multivariate analyses, using mandibular measurements, generally separate the Watom and Lapita mandibles from other Pacific and Asiatic groups but hint of a possible biological connection with eastern Melanesian (and possibly Polynesian) populations. These conclusions should be viewed as tentative until much larger, and earlier dated, Lapita-associated skeletal samples become available.

ACKNOWLEDGEMENTS. I wish to thank Jim Specht (The Australian Museum), Roger Green (Auckland University) and Dimitri Anson (Otago Museum), excavators of the Watom site for their permission to examine the Watom skeletal material. Dr Philip Houghton (University of Otago) graciously allowed me to work with the Watom and Tongan remains in his research laboratory in 1987. Further thanks are accorded Wal Ambrose for allowing me to study the Manus mandible. Professor C.F.W. Higham (Department of Anthropology) of the University of Otago, kindly provided technical assistance during my stay in Dunedin. Mr Martin Fisher (Department of Anthropology) did the photography of the osteological specimens presented in the report for which I am most grateful. My thanks to Martha L. White for making additional copies of the prints. I am further indebted to Michele Toomay Douglas who helped with the statistical analysis of the data and Lou Jane M. Lee who drew the illustrations. Various members of the Anthropology Office staff helped with the preparation of the manuscript. My sincere thanks to all.

Travel funds to examine the Watom skeletons in New Zealand in 1987 was provided by a University of Hawaii Research and Training Revolving Fund grant and a University of Hawaii Research Relations Fund Award. Further support for research reported here was provided by the Wenner-Gren Foundation for Anthropological Research (Grant No. 4564).

References

- Ambrose, W., 1988a. A bronze find in PNG. *Australian Natural History* 22: 415.
- Ambrose, W., 1988b. An early bronze artifact from Papua New Guinea. *Antiquity* 62: 483-491.
- Anderson, J.E., 1969. *The Human Skeleton. A Manual for Archaeologists*. National Museum of Man, Ottawa. v + 165 pp.
- Bass, W.M., 1988. *Human Osteology: A Laboratory and Field Manual of the Human Skeleton*. 3rd edn. Missouri Archaeological Society, Missouri. xviii + 327 pp.
- Best, S., 1977. Archaeological investigations on Lakeba, Lau Group, Fiji. *New Zealand Archaeological Association Newsletter* 20: 28-38.
- Brace, C.L. & R.J. Hinton, 1981. Oceanic tooth-size variation as a reflection of biological and cultural mixing. *Current Anthropology* 22: 549-569.
- Brothwell, D.R., 1981. *Digging Up Bones*. The British Museum (Natural History), London. iv + 208 pp.
- Corruccini, R.S., 1975. Multivariate analysis in biological anthropology: some considerations. *Journal of Human Evolution* 4: 1-19.
- Dixon, W.J. & M.B. Brown (eds), 1979. *BMDP-79. Biomedical Computer Programs P-Series*. University of California Press, Berkeley. xiii + 880 pp.
- El-Najjar, M.Y. & T.W. McWilliams, 1978. *Forensic Anthropology*. C.C. Thomas, Springfield, IL. xiv + 190 pp.
- Gilbert, B.M. & T.W. McKern, 1973. A method of aging the female Os pubis. *American Journal of Physical Anthropology* 38: 31-38.
- Green, R.C. Personal communication, letter dated January 4, 1989.

- Green, R.C. & D. Anson, 1987. The Lapita site of Watom: new evidence from excavations in 1985. *Man in Oceania* 3: 121–131.
- Houghton, P., 1980. *The First New Zealanders*. Hodder and Stoughton, Auckland. 156 pp.
- Houghton, P., B.F. Leach & D.G. Sutton, 1975. Estimation of stature of prehistoric Polynesians in New Zealand. *Journal of Polynesian Society* 84: 325–336.
- Howells, W.W., 1969. The use of multivariate techniques in the study of skeletal populations. *American Journal of Physical Anthropology* 31: 311–314.
- Howells, W.W., 1970. Anthropometric grouping analysis of Pacific peoples. *Archaeology and Physical Anthropology in Oceania* 5: 192–217.
- Howells, W.W., 1972. Analysis of patterns of variation in crania in recent man. pp. 123–151. *In* (R. Tuttle, ed.). *The Functional and Evolutionary Biology of Primates*. Aldine, Chicago.
- Howells, W.W., 1973. Cranial Variation in Man. *Papers of the Peabody Museum of Archaeology and Ethnology* Vol. 67. Harvard University, Cambridge. 259 pp.
- Kowalski, C.J., 1972. A commentary on the use of multivariate statistical methods in anthropometric research. *American Journal of Physical Anthropology* 36: 119–132.
- Krogman, W.M. & M.Y. Iscan, 1986. *The Human Skeleton in Forensic Medicine*. 2nd edn. C.C. Thomas, Springfield, IL. xv + 551 pp.
- McKern, T.W. & T.D. Stewart, 1957. Skeletal Age Changes in Young American Males, Analyzed from the Standpoint of Age Identification. Environmental Protection Research Division (Quartermaster Research and Development Center, U.S. Army, Natick, Massachusetts) Technical Report EP-45. 127 pp.
- Mahalanobis, P.C., 1936. On the Generalized Distance in statistics. *Proceedings of the National Institute of Sciences of India* 2: 49–55.
- Martin, R., 1957. *Lehrbuch der Anthropologie*. Band I. Gustav Fischer, Stuttgart. viii + 661 pp.
- Pietrusewsky, M., 1969. An osteological study of cranial and infracranial remains from Tonga. *Records of the Auckland Institute and Museum* 6: 287–402.
- Pietrusewsky, M., 1974. Non Nok Tha. *The Human Skeletal Remains from the 1966 Excavations at Non Nok Tha, Northeastern Thailand*. Otago University Studies in Prehistoric Anthropology. Vol. 6. Department of Anthropology, University of Otago, Dunedin. v + 148 pp.
- Pietrusewsky, M., 1976. Prehistoric Human Remains from Papua New Guinea and the Marquesas. *Asian and Pacific Archaeology Series No. 7*. Social Sciences Linguistic Institute, University of Hawaii, Honolulu. xvi + 191 pp.
- Pietrusewsky, M., 1977. Étude des relations entre les populations du Pacifique par les méthodes d'analyse multivariée appliquées aux variations crâniennes. *L'Anthropologie* 81: 67–97.
- Pietrusewsky, M., 1984. Metric and Non-Metric Cranial Variation in Australian Aboriginal Populations Compared with Populations from the Pacific and Asia. *Occasional Papers in Human Biology* No. 3. Australian Institute of Aboriginal Studies, Canberra. xi + 113 pp.
- Pietrusewsky, M., 1985a. The earliest Lapita human remains from the Pacific: a mandible fragment from Natunuku, Fiji. *American Journal of Physical Anthropology* 66: 214.
- Pietrusewsky, M., 1985b. The earliest Lapita human remains from the Pacific: a multivariate analysis of a mandible fragment from Natunuku, Fiji. *Journal of the Polynesian Society* 94: 389–414.
- Poulsen, J., 1987. Early Tongan Prehistory. *The Lapita Period on Tongatapu and its Relationships*. Vols 1 and 2. *Terra Australis* Vol. 12. Department of Prehistory, Research School of Pacific Studies, The Australian National University, Canberra. xxiii + 307 and x + 205 pp.
- Rao, C.R., 1952. *Advanced Statistical Methods in Biomedical Research*. John Wiley, New York.
- Saunders, S.R., 1978. The Development and Distribution of Discontinuous Morphological Variation of the Human Infracranial Skeleton. *Archaeological Survey of Canada Paper No. 81*. National Museum of Man, Mercury Series, Ottawa. xxi + 548 pp.
- Shaw, E., 1967. A re-analysis of pottery from Natunuku and Vuda, Fiji. M.A. thesis, University of Auckland, Auckland.
- Shaw, E., 1975. The decorative system of Natunuku, Fiji. pp. 44–54. *In* (S.M. Mead, L. Birks, H. Birks and E. Shaw, eds). *The Lapita Pottery Style of Fiji and Its Associations*. Polynesian Society Memoir No. 38. Polynesian Society, Wellington.
- Specht, J., 1968. Preliminary report of excavations on Watom Island. *Journal of the Polynesian Society* 77: 117–134.
- Spennemann, D., 1987. Appendix 9. Reanalysis of the human remains at To.1. pp. 289–303. *In* (J. Poulsen). *Early Tongan Prehistory*. Vol. 1. *Terra Australis* Vol. 12. Department of Prehistory, Research School of Pacific Studies, The Australian National University, Canberra.
- Spriggs, M., Personal communication, letter written in December, 1988.
- Steele, D.G., 1970. Estimation of stature from fragments of long limb bones. pp. 85–97. *In* (T.D. Stewart, ed.). *Personal Identification in Mass Disasters*. National Museum of Natural History, Washington, D.C.
- Stewart, T.D., 1979. *Essentials of Forensic Anthropology*. C.C. Thomas, Springfield, IL. xvii + 300 pp.
- Trotter, M., 1970. Estimation of stature from intact limb bones. pp. 71–83. *In* (T.D. Stewart, ed.). *Personal Identification in Mass Disasters*. Smithsonian Institution, National Museum of Natural History, Washington, D.C.
- Ubelaker, D.H., 1984. *Human Skeletal Remains: Excavation, Analysis, Interpretation*. Aldine Publishing Company, Chicago. xi + 119 pp.
- van Vark, G.N., 1976. A critical evaluation of the application of multivariate statistical methods to the study of human populations from their skeletal remains. *Homo* 27: 94–114.
- van Vark, G.N. & W.W. Howells, 1984. *Multivariate Statistical Methods in Physical Anthropology*. D. Reidel Publishing Company, Dordrecht. x + 433 pp.
- von Luschan, F., 1897. *Deutschland und seine Kolonien im Jahre 1896*. *Amtlicher Bericht über die erste deutsche Kolonial-Ausstellung*, Berlin.

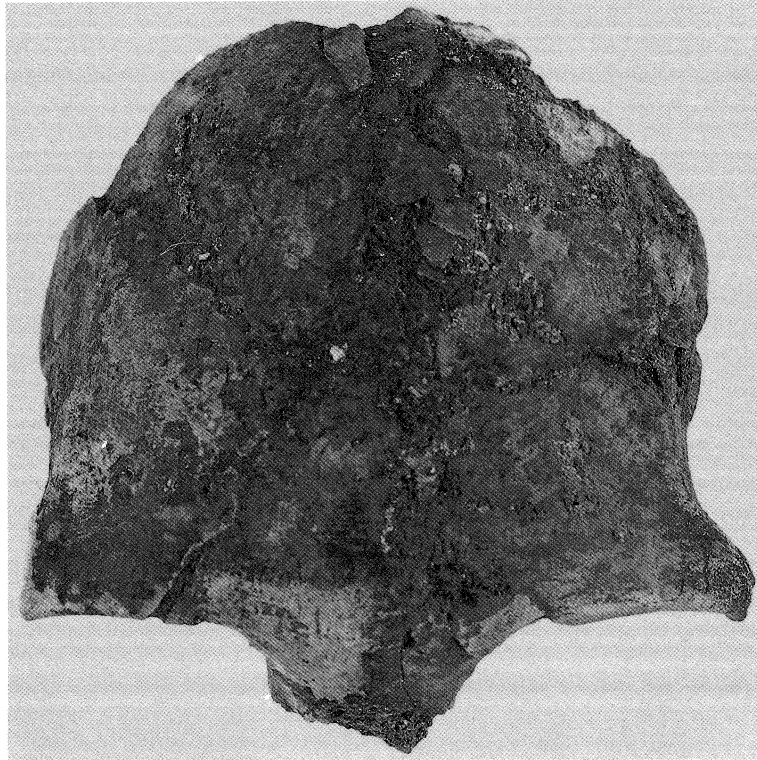
Appendix A

Plate 1. Frontal bone of Burial 3. The skull of this burial, while fragmented, is one of the most complete crania from Watom.

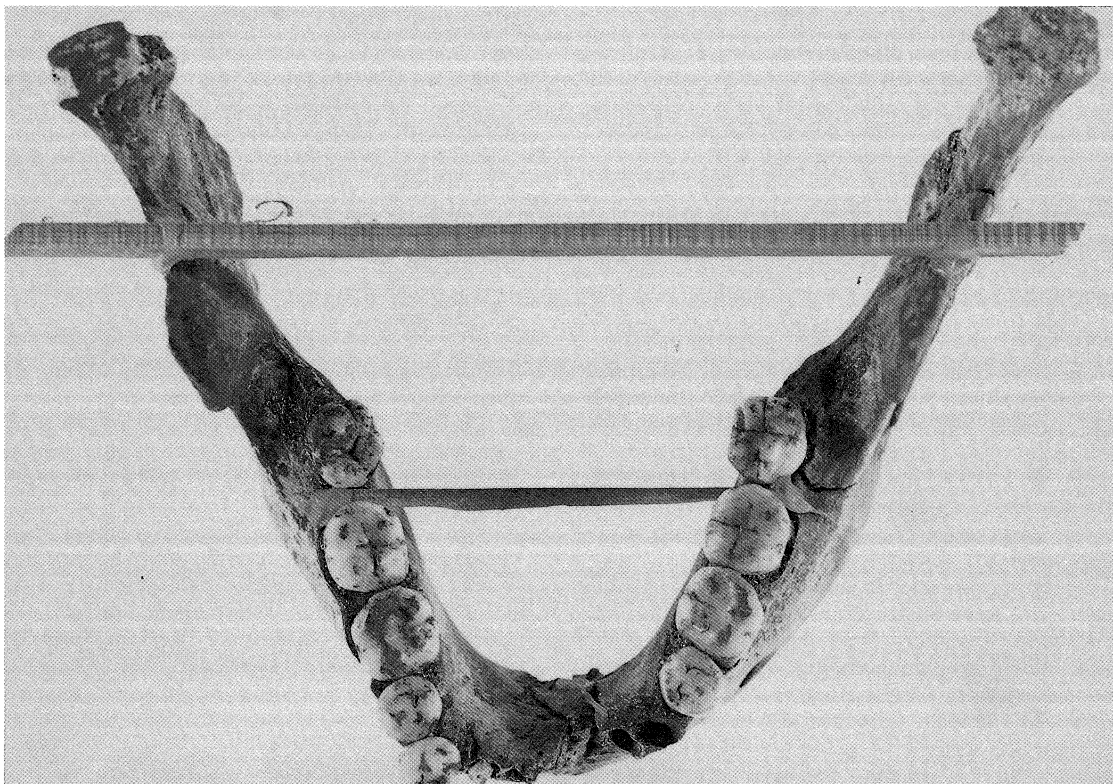


Plate 2. Occlusal view of the mandible of Burial 3 from Watom. The teeth exhibit moderate wear. Some of the anterior teeth were lost before death. There are no caries or dental abscessing. The “+4” pattern is the predominant molar cusp pattern in this specimen.



Plate 3. Frontal view of the mandible of Burial 3. There is postmortem damage in the symphysis region.



Plate 4. Lateral (right) view of the mandible of Burial 3. The ramus is low and broad and the body is short. The rocker jaw condition is present. The mental foramen is single.

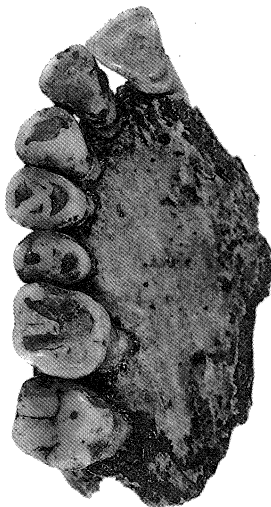


Plate 5. Occlusal view of the two maxillary fragments of Burial 3 from Watom. Tooth wear has exposed the dentin.



Plate 6. Lateral view of the right maxilla fragment of Burial 3. The enamel and roots of the teeth are stained.



Plate 7. Occlusal view of the mandible belonging to Watom Burial 6. The superior portion of the right ramus is damaged and missing. There is tooth crowding in the incisor region. The dentin is exposed in some of the teeth.



Plate 8. Frontal view of the damaged mandible of Watom Burial 6. Encrustations are visible in the anterior teeth.

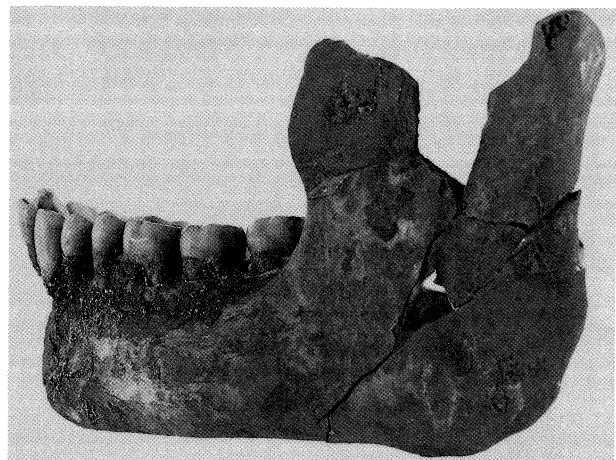


Plate 9. Lateral (left) view of Watom Burial 6 mandible. The mandible is not a rocker jaw. Note the broad ramus.

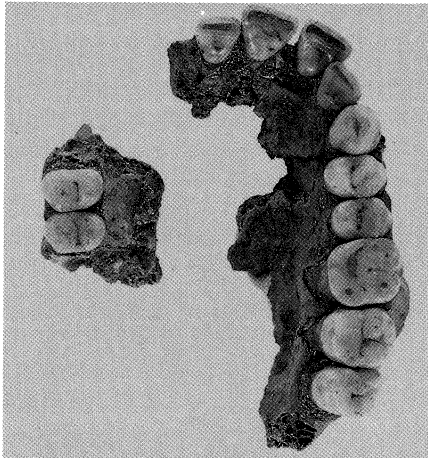


Plate 10. Occlusal view of two maxilla fragments of Watom Burial 6. The left third molar is reduced in size.

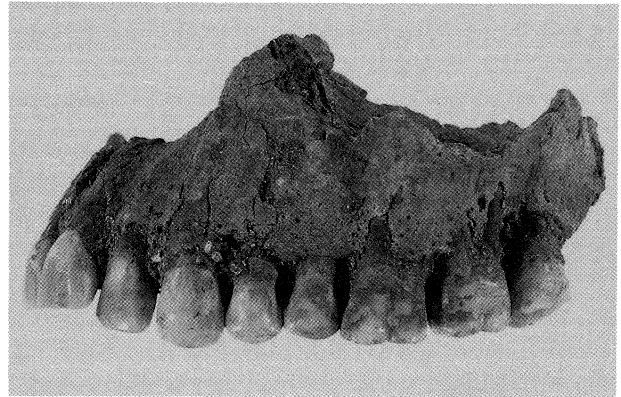


Plate 11. Lateral view of the left maxilla fragment of Watom Burial #6. There is some discolouration of the enamel.



Plate 12. Some of the long limb bones belonging to Watom Burial 2.

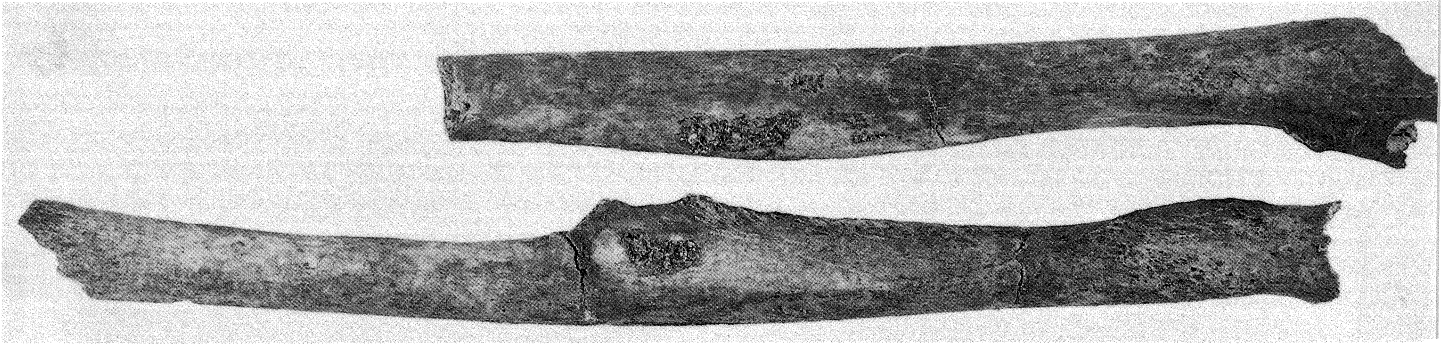


Plate 13. Shaft fragments of the left radius and ulna of Watom Burial 2. The interosseous border of the radius, where the abductor pollicis longus attaches, is strongly developed. The same area in the right radius is less strongly developed.

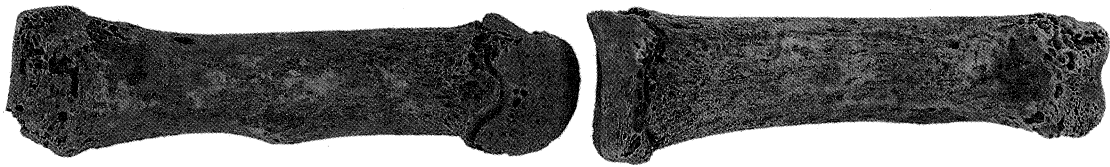
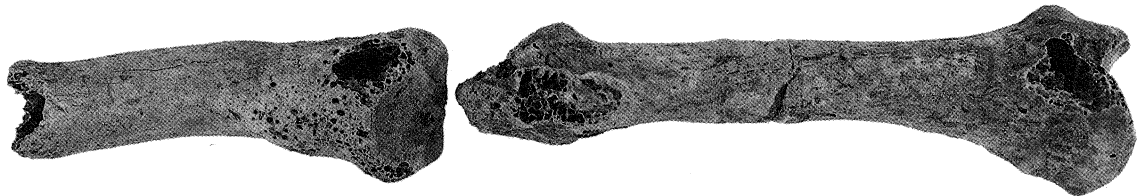


Plate 14. The left fifth metacarpal and proximal phalanx of Watom Burial 2. The metacarpal exhibits a possible healed fracture about mid-shaft. The epiphyseal line of fusion is still evident.

A



B

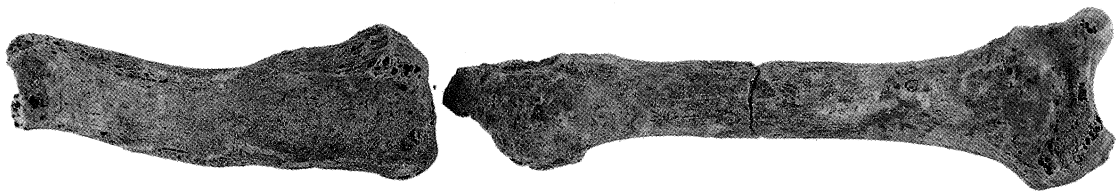


Plate 15. Anterior (A) and posterior (B) views of the left second metacarpal and proximal phalanx of Watom Burial 3. The proximal end of the phalanx is misaligned and exhibits a possible healed fracture and periostitis. Swelling and porosity are further evident.



Plate 16. Some of the major infracranial bones and bone fragments from Watom Burial 4.

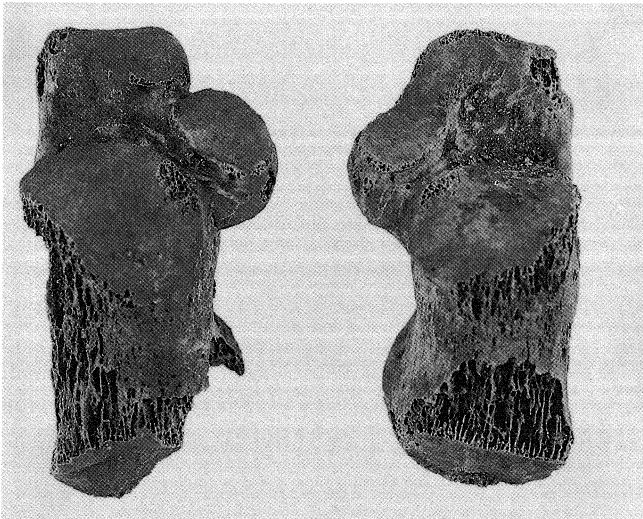


Plate 17. Right and left calcanei of Watom Burial 4. The anterior and middle articular surfaces for the talus are separate on the left. The same surfaces are connected and hour-glass-shaped on the right.

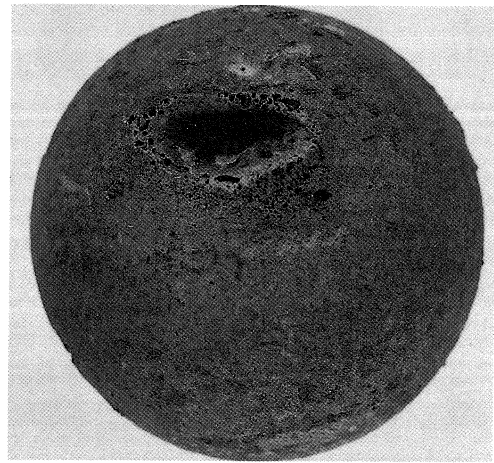


Plate 18. The head of the right femur of Watom Burial 4 showing an oval-shaped fovea capitis, the site of attachment for the ligament for the femur head.



Plate 19. The head and neck region of the right femur of Watom Burial 5 exhibiting a Fossa of Allen or cervical fossa in the anterior superior margin of the femoral neck. The underlying trabeculae are exposed.

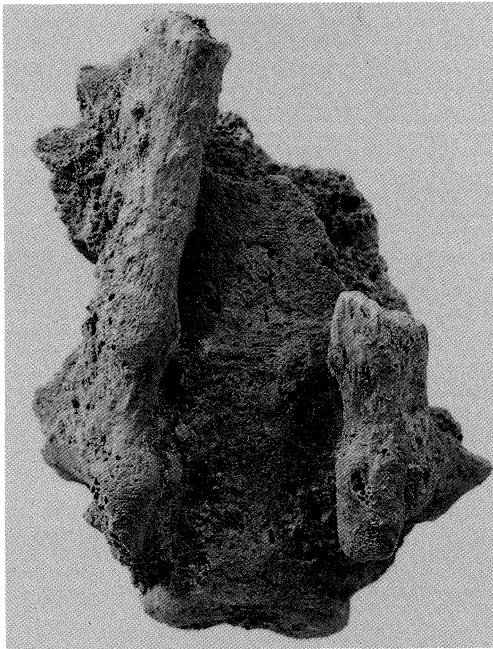


Plate 20. Fragment of the posterior region of the sacrum of Watom Burial 5 exhibiting sacral hiatus.

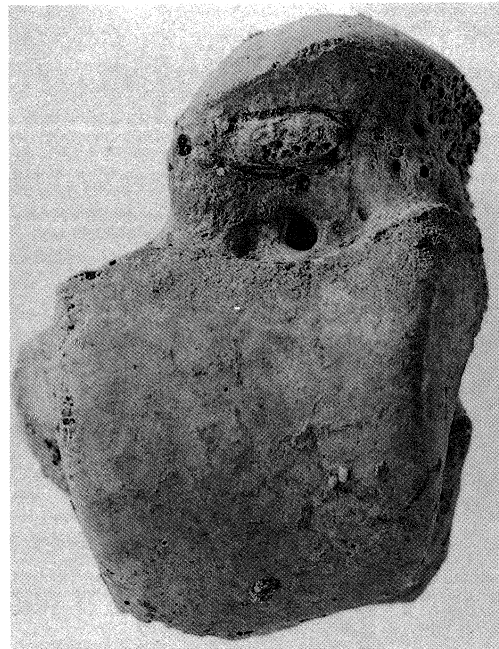


Plate 21. Left talus of Watom Burial 5 exhibiting a squatting facet in the neck region.



Plate 22. Some of the major upper limb bones and fragments of Watom Burial 6. With the exception of the skull, this is the most complete and best preserved skeleton from Watom.

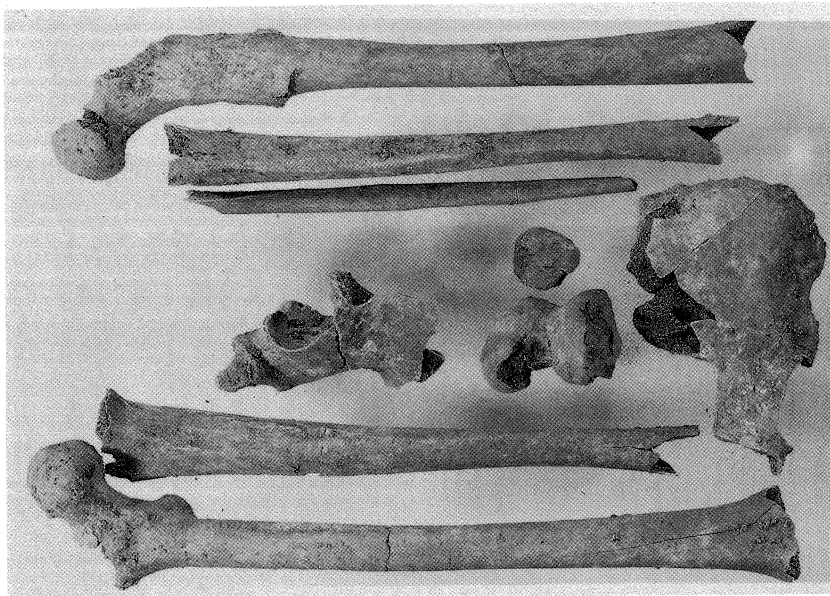


Plate 23. Overview of some of the major lower limb bones from Watom Burial 6.

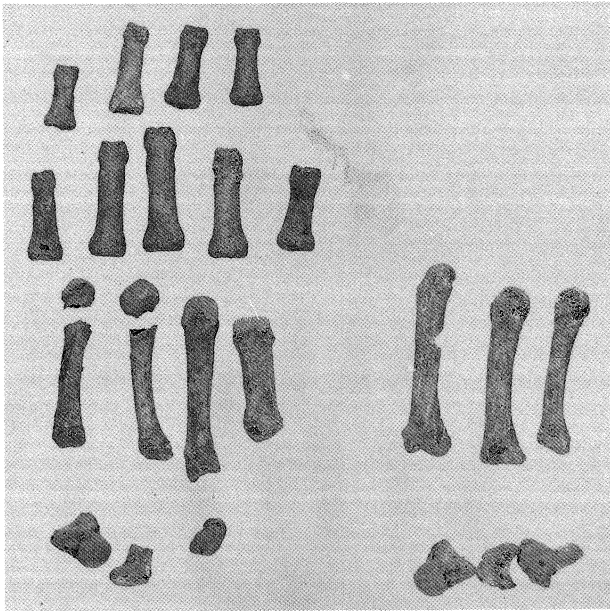


Plate 24. Hand bones from Watom Burial 6.

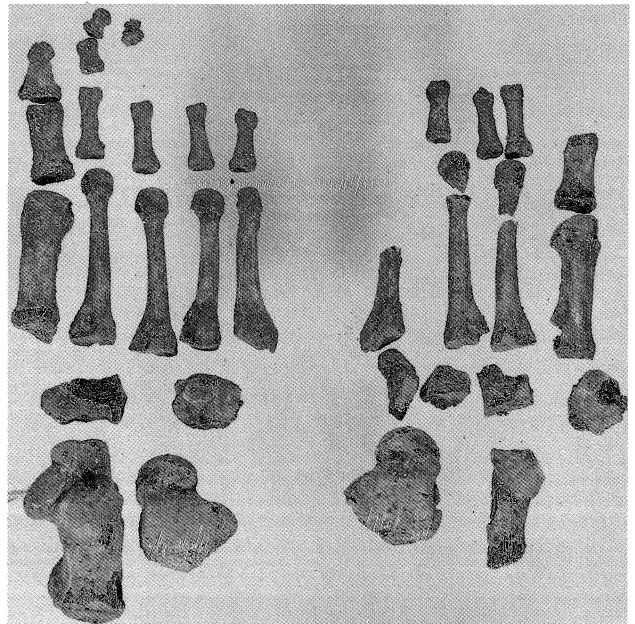


Plate 25. Foot bones from Watom Burial 6.

A



B



Plate 26. (A) Inferior surface of the right clavicle of Watom Burial 6. The impression for the costoclavicular ligament is deepened into a sulcus. A facet is visible in the region of the trapezoid line at the lateral end of the same bone. (B) Superior surface of the right clavicle of Watom Burial 6.



Plate 27. (A) Anterior view of the proximal end of the left femur of Watom Burial 6 exhibiting a possible healed fracture with extensive periostitis. (B) Posterior view of the proximal end of the left femur from Watom Burial 6. There is postmortem damage in the region of the greater trochanter.

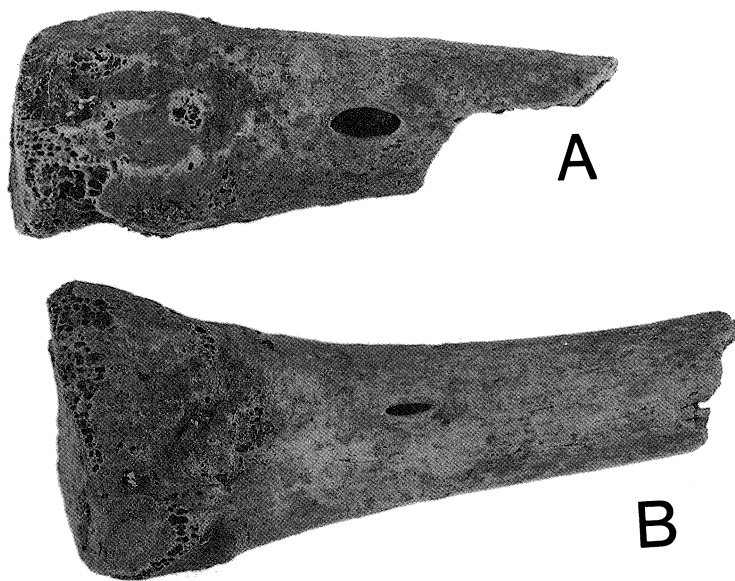


Plate 28. (A) Lateral view of the right third metatarsal found intrusively with Watom Burial 7. (B) Lateral view of the left fourth metatarsal of Watom Burial 6. Both metatarsals exhibit enlarged nutrient foramina.



Plate 29. Right lateral view of the mandible and portion of the right temporal bone of Burial AK, a Lapita-associated skeleton from Tongatapu, Tonga. The right condyle is pathological but articulates with the right temporal fragment. The lower first premolar is carious. The alveolar margins exhibit considerable resorption.

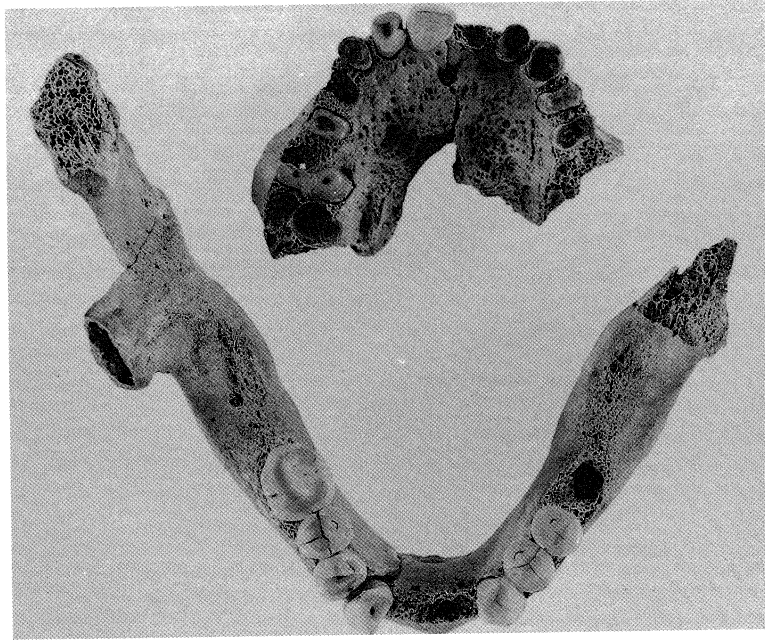


Plate 30. Occlusal view of the maxilla and mandible fragments of Burial AK. Many of the teeth, not loss premortem are worn and carious.

Appendix B

Table 1. Individual Descriptions of Watom Burials.

Site SAC (Site 8)

Burial No.: 1

Provenience (Excavator, year, rectangle): Specht, 1966, Rect. I

Age: 30 years (auricular surface, degeneration).

Sex: Female (sciatic notch, pre-auricular sulcus and femoral head diam.).

Stature: 164 cm (5'5") The length of the right femur was estimated to be 42.9 cm using Steele's (1970) segment measurement No. 1 (7.7 cm); stature was estimated using formula No. 1 of Houghton *et al.* (1975).

Completeness: No skull. Infracranial skeleton is substantially incomplete and many bones are broken. Except for patellae and some hand and foot bones, none of the limb bones are complete.

Intrusive human remains: Right fourth metacarpal.

Preservation: Fair. The hand and foot bones and patellae are the best preserved bones. Bones are light in weight. Some reconstruction was achieved.

Pathology: There is little or no osteoarthritis in these remains.

Anomalies: An anomalous foramen was observed on the inferior surface of the right clavicle anterior to the site of attachment for the conoid ligament. The site of attachment of the deltoid muscles on the superior surfaces of both clavicles is well developed.

Comments: Tibiae, right fibula and patella and some hand and foot bones were assigned to this individual from associated miscellaneous material. Some lower long limb bone fragments were sacrificed for chemical analyses prior to this study.

Burial No.: 2

Provenience (Excavator, year, rectangle): Specht, 1966, Rect. I/III

Age: 18-20 years (the distal epiphysis of the fifth metacarpal exhibits recent fusion)

Sex: Female (sciatic notch, size and muscle markings).

Stature: 154.7 cm. (5'1") Segment No. 2 (21.1 cm) of the left femur yielded a maximum length of 38.7 cm. (Steele 1970). Stature was estimated using Houghton *et al.* (1975) formula No. 7.

Completeness: No skull. Infracranial skeleton is represented by forearm and bones of the lower limb skeleton, a fragment of the right innominate and a single lumbar vertebra fragment. Hands and feet are relatively incomplete.

Preservation: Fair/Good.

Pathology: Possible healed fracture of left fifth metacarpal bone. There is no osteoarthritis in the appendicular skeleton.

Anomalies: Interosseous borders of both radii are extremely well developed. The soleal line on the posterior surface of the right tibia exhibits a raised roughened prominence at its commencement.

Comments: A box, previously unopened before this study, contained the distal ends of the right fibula and ulna and several metapodial bones.

Burial No.: 3

Provenience (Excavator, year, rectangle): Specht, 1966, Rect. I

Age: 30-40 years (dental attrition and degeneration).

Sex: Male (some pelvic indicators, sciatic notch and pre-auricular sulcus, suggest the sex is female while the lower limb bones indicate male. The skull possesses predominantly male features).

Stature: 176.2 cm (5'9") Stature was estimated using the right femur segment measurement No. 4 (3.9 cm) and Houghton *et al.* (1975) formula No. 1.

Completeness: Partial skull and very fragmentary infracranial skeleton. The most intact portions of the latter include the hand and foot skeletons, and shafts of the right humerus and both femora. The skull is in pieces, some of which have solidified into a calcified mass. The right parietal is warped. The most complete bones of the skull include the frontal, right parietal and right zygoma. Large portions of the left parietal and temporal bones, a mandible, occipital fragment and right maxilla containing teeth are further preserved.

Preservation: Fair/Poor. Concretions have solidified major portions of the cranial vault.

Pathology: Periodontal disease but no dental caries; there is little or no osteoarthritis.

Anomalies: Alveolar prognathism.

Comments: Fibula and some limb bone shaft fragments were removed for chemical analyses prior to this study. Several hand and foot bones were assigned to this burial from miscellaneous material. The mandible is robust and is classified as a rocker jaw.

Burial No.: 4

Provenience (Excavator, year, rectangle): Green & Anson, 1985, Rect I/IV

Age: 35 (based on McKern & Stewart (1957) symphysis pubis aging method: 23-39 years and lack of extensive degeneration).

Sex: Male (pelvic indicators: narrow sciatic notch and absence of pre-auricular sulcus and parturition pits; femoral head diameter).

Stature: 170 cm (5'7") Stature was estimated using the right femur segment measurement No. 2 (23.5 cm) and Houghton *et al.* (1975) formula No. 1.

Completeness: No skull. Infracranial skeleton is substantially complete but fragmentary. Forearm bones, left tibia, sternum and right patella are missing. Only some of the hand and foot bones are completely intact.

Preservation: Fair/Poor. The right humerus and both femora, and the hand and foot bones are best preserved.

Pathology: Some osteoarthritis is present in the infracranial skeleton.

Anomalies:

Comments: Material required extensive cleaning and mending before being studied. A small bag of bones labeled, "bones from burial at west and centre part. May 22, 1985 Burial 4(?)", which include the right metacarpals 1, 2 and 4 and a portion of the atlas vertebra, belong to this burial. Fibula fragments were removed for chemical analyses prior to this study.

Burial No.: 5

Provenience (Excavator, year, rectangle): Green & Anson, 1985, Rect I/III

Age: 30 years (auricular surface, sternal end of rib).

Sex: Male (sciatic notch, absence of pre-auricular sulcus; limb bone diameters).

Stature: 173.7 cm (5'8") Stature was based on the maximum length of the left humerus (32.5 cm) and Houghton *et al.* (1975) formula No. 10.

Completeness: No skull. Infracranial skeleton represented by fragments of humeri, right femur, fibulae, patellae, left clavicle, scapulae, vertebrae, innominates, hands and feet.

Intrusive human remains: Left talus, left second cuneiform, left navicular fragment, left patella, fragment of left acetabulum, right proximal phalanx of first metatarsal, and metacarpals 2 through 5 from right hand.

Preservation: Good/Fair. Once encrustations were removed, the hands, feet, left humerus, right fibula and major portions of the innominate bones were found to be well preserved.

Pathology: Partial sacral hiatus; there is little or no osteoarthritis.

Anomalies: Right fibula is unusually long and exhibits swelling in the region of the peroneus brevis attachment at the proximal end of this bone. A Fossa of Allen is present in the right femur.

Comments: Rib fragments and several fibula fragments were removed for chemical analyses prior to this study. Animal bones and teeth, obsidian and pot sherds were found associated with these remains at the time of this study.

Burial No.: 6

Provenience (Excavator, year, rectangle): Green & Anson, 1985, Rect. III

Age: 30-35 years (lack of osteoarthritis, slight to moderate dental wear).

Sex: Male (sciatic notch, mastoid and general bone size indicate male).

Stature: 180 cm (5'11") based on maximum length of left humerus (35.0 cm) and Houghton *et al.* (1975) formula No. 10.

Completeness: Partial cranium and substantially complete mandible. The infracranial skeleton is substantially complete, only the right fibula, some hand and foot bones, sacrum, and most of the sternum are missing. The left arm limb bones, clavicles and right radius are complete.

Preservation: Good. This is the best preserved burial. Bones were mended (re-mended) after a thorough washing.

Pathology: Proximal end of left femur exhibits extensive reactive bone formation and periosteal inflammation. No dental caries but there is evidence of periodontal disease and slight to moderate degrees of dental attrition in the teeth.

Anomalies: The teeth exhibit some discolouration, and there is tooth crowding. The mandible is not a rocker jaw. The fourth metatarsal possesses an enlarged nutrient foramen.

Comments: Most of the ribs have been sacrificed for citrate analysis.

Burial No.: 7

Provenience (Excavator, year, rectangle): Green & Anson, 1985, Rect III/IV

Age: Adult

Sex: Male (the limb bones are large)

Stature: 172.7 cm (5'8") Stature is based on right femur segment No. 2 (24.8 cm) and Houghton *et al.* (1975) formula No. 1.

Completeness: The cranium is represented by sixteen small fragments. The infracranial skeleton is represented by fragments of right scapula, vertebrae, right and left radius, distal end of right ulna, right femur, patella, right and left fibulae, right (?) tibia and some hand and foot bones.

Intrusive human remains: Left calcaneus, right third metatarsal fragment and an isolated premolar.

Preservation: Fair. Some reconstruction was attempted after washing.

Pathology: Slight osteoarthritis is present in the hand and foot bones.

Anomalies: An enlarged nutrient foramen was observed in an intrusive metatarsal (MT3) found with this burial.

Comments: Animal remains were found to be associated with this burial. Two human tarsal bones (left navicular and a third cuneiform) were assigned to this burial from the miscellaneous material. Fibula fragments were removed for chemical analyses prior to this study.

Burial No.: 8

Provenience (Excavator, year, rectangle): Green & Anson, 1985, Rect I/IV

Age: Adult (approx. 35 years).

Sex: Male (the limb bones are large).

Stature: 171.9 cm (5'7") based on left tibia segment No. 3 (13.6 cm) and Houghton *et al.* (1975) formula No. 8.

Completeness: No skull. Scapula and vertebra fragments represent the upper axial skeleton. The rest of the upper limb skeleton is missing. The lower limb skeleton is substantially complete but fragmentary.

Preservation: Fair. Remains were washed and reconstructed. The right foot is the best preserved part of the skeleton.

Pathology: Slight osteoarthritis in the limb skeleton.

Anomalies: The soleal line on the left tibia is very prominent. The left tibia appears to be larger than the right tibia.

Comments: Tibiae were treated with a 7% acetic acid solution to remove encrustations. The right scapula fragment, right femur, patella fragments and some hand and foot bones were assigned to this burial from associated miscellaneous material.

Table 2. Measurements recorded in crania from Watom Island and their descriptive statistics.

Variable ¹	Burial No.			Watom	
	3	6	N	Mean	S.D.
MAXFRONB	101		1	101.0	
MINFRONB	94		1	94.0	
BISTEPHB	87		1	87.0	
NASALBTH	26		1	26.0	
ALVEOLAL	59	61	2	60.0	1.4
MASTOIDH		31	1	31.0	
MASTOIDW		19	1	19.0	
BIORBITB	103		1	103.0	
INTERORB	31		1	31.0	
MALRLINF	26	44	2	35.0	12.7
MALRLMAX	39	55	2	47.0	11.3
CHEEKHGT	25	23	2	24.0	1.4
NASIBGCR	106		1	106.0	1.4
BRGLMDCR	92		1	92.0	
NASFROSB	14		1	14.0	

¹ MAXFRONB = Maximum frontal breadth, MINFRONB = Minimum frontal breadth, BISTEPHB = Bistephanic breadth, NASALBTH = Nasal breadth, ALVEOLAL = Alveolar length, MASTOIDH = Mastoid height, MASTOIDW = Mastoid width, BIORBITB = Biorbital breadth, INTERORB = Interorbital breadth, MALRLINF = Inferior malar length, MALRLMAX = Maximum malar length, CHEEKHGT = Cheek height, NASIBGCR = Nasion-bregma chord, BRGLMDCR = Bregma-lambda chord, NASFROSB = Nasio-frontal subtense.

Table 3. Measurements recorded in Lapita mandibles.

	Watom				Lakeba		Manus	Natunuku	Tonga
	3	6	M 1	M 2	1	2			
Mandibular length	96	91						108	
Inferior length	53	74		65	64		65	68	60
Alveolar length	58	49		66			64	71	54
Bicondylar width	139							114	
Bicondylar articular breadth	123								
Bicoronoid breadth	100	88							
Bigonial breadth	108	97						100	100
Bicanine external breadth	34	31					35	37	31
Bimolar-1 external breadth	62	56					68		61
Bimolar-3 external breadth	74	65					80		73
Symphyseal height	36	29	26	30	28	30	28	26	27
Mental foramen height	33	29	31	28	28	32	29	19	29
Canine height at C/P3	34	28	30	29	29	32	30	22	28
Molar height at M1/M2	30	27	30	27	28	29	27		26
Symphyseal breadth	15	12	15	12	14	13	16	14	14
Mental foramen breadth	13	10	12	11	11	11	12	11	10
Canine breadth	12	11	14	11	10	9	13	12	11
Molar breadth	16	13	15	13	13	13	14	13	14
Ramus height	65	72		51				60	61
Ramus breadth	43	44		41	31			33	41
Mandibular notch breadth	45	37						37	
Condyle length	11	10	11						
Condyle breadth	17	22	19						
P3-M1 length	25	22	22	26	15	14	30		26
M1-M2 length	23	20		23	18		23		
M1-M3 length	37	33		33			38		

Table 4. Descriptive statistics for measurements and indices recorded in male Lapita-associated mandibles.

Variable ¹	Watom			Lakeba			Natunuku		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
MANDLNTH	2	93.5	3.5	0			1	108.0	
INFMANDL	3	64.0	10.5	1	64.0		1	68.0	
ALVEOLGT	3	57.7	8.5	0			1	71.0	
BICONDWH	1	139.0		0			1	114.0	
MIDCONDW	1	123.0		0			0		
CORONBTH	2	94.0	8.5	0			0		
BIGONIAL	2	102.5	7.8	0			1	100.0	
BICANBTH	2	32.5	2.1	0			1	37.0	
FRMOLBTH	2	59.0	4.2	0			0		
THMOLBTH	2	69.5	6.4	0			0		
SYMPHYHT	4	30.3	4.2	2	29.0	1.4	1	26.0	
MENFORHT	4	30.3	2.2	2	30.0	2.8	1	19.0	
CANINEHT	4	30.3	2.6	2	30.5	2.1	1	22.0	
MOLARHT	4	28.5	1.7	2	28.5	0.7	0		
SYMPHYBH	4	13.5	1.7	2	13.5	0.7	1	14.0	
MENFORBH	4	11.5	1.3	2	11.0	0.0	1	11.0	
CANINEBH	4	12.0	1.4	2	9.5	0.7	1	12.0	
MOLARBH	4	14.3	1.5	2	13.0	0.0	1	13.0	
RAMUSHGT	3	62.7	10.7	0			1	60.0	
RAMUSBTH	3	42.7	1.5	1	31.0		1	33.0	
MANDNOTB	2	41.0	5.7	0			1	37.0	
CONDYLG	3	10.7	0.6	0			0		
CONDBTH	3	19.3	2.5	0			0		
PMMOLARL	4	23.8	2.1	2	14.5	0.7	0		
MONETWO	3	22.0	1.7	1	18.0		0		
MONETHRE	3	34.3	2.3	0			0		
MANDINDX	1	69.1		0			1	94.7	
GONCONDX	1	77.7		0			1	87.7	
RAMUSIND	3	69.2	10.0	0			1	55.0	
ROBUST	4	38.0	2.3	2	36.8	3.5	1	57.9	
Variable	Tonga(AK)			Manus			Combined (All Lapita Mandibles)		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
MANDLNTH	0			0			3	98.3	8.7
INFMANDL	1	60.0		1	65.0		7	64.1	6.5
ALVEOLGT	1	54.0		1	64.0		6	60.3	8.2
BICONDWH	0			0			2	126.5	17.7
MIDCONDW	0			0			1	123.0	
CORONBTH	0			0			2	94.0	8.5
BIGONIAL	1	100.0		0			4	101.3	4.7
BICANBTH	1	31.0		1	35.0		5	33.6	2.6
FRMOLBTH	1	61.0		1	68.0		4	61.8	4.9
THMOLBTH	1	73.0		1	80.0		4	73.0	6.2
SYMPHYHT	1	27.0		1	28.0		9	28.9	3.1
MENFORHT	1	29.0		1	29.0		9	28.7	4.0
CANINEHT	1	28.0		1	30.0		9	29.1	3.3
MOLARHT	1	26.0		1	27.0		8	28.0	1.5
SYMPHYBH	1	14.0		1	16.0		9	13.9	1.4
MENFORBH	1	10.0		1	12.0		9	11.2	1.0
CANINEBH	1	11.0		1	13.0		9	11.4	1.5
MOLARBH	1	14.0		1	14.0		9	13.8	1.1
RAMUSHGT	1	61.0		0			5	61.8	7.7
RAMUSBTH	1	41.0		0			6	38.8	5.5
MANDNOTB	0			0			3	39.7	4.6
CONDYLG	0			0			3	10.7	0.6
CONDBTH	0			0			3	19.3	2.5
PMMOLARL	1	26.0		1	30.0		8	22.5	5.6
MONETWO	0			1	23.0		5	21.4	2.3
MONETHRE	0			1	38.0		4	35.3	2.6

Table 4 (cont'd).

Variable	Tonga(AK)			Manus			Combined (All Lapita Mandibles)		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
MANDINDX	0			0			2	81.9	18.2
GONCONDX	0			0			2	82.7	7.1
RAMUSIND	1	67.2		0			5	66.0	9.4
ROBUST	1	34.5		1	41.4		9	39.9	7.2

¹For explanation of abbreviations for mandibular measurements and indices see Pietrusewsky's Natunuku report (this volume).

Table 5. Summary of non-metric observations recorded in adult crania from Watom Island.

Trait	Watom	
	n/N	%
Metopism		
absent	1/1	100.0
Frontal groove		
absent	2/2	100.0
Supraorbital structure		
single notch	1/1	100.0
Spina trochlea		
absent	2/2	100.0
Zygofacial foramen		
single	3/3	100.0
Nasal frontal suture		
omega	1/1	100.0
Subnasal		
blurred	1/1	100.0
Marginal tubercle		
none	1/1	100.0
Palatine torus		
none	1/1	100.0
Maxillary torus		
none	2/2	100.0
Parietal foramen		
single	1/1	100.0
Parietal notch		
none	1/1	100.0
Tympanic thickening		
present	1/1	100.0
Tympanic dehiscence		
absent	1/1	100.0
Tympanic marginal foramen		
absent	1/1	100.0
Auditory exostosis		
absent	1/1	100.0

Table 6. Summary of non-metric variation recorded in Lapita mandibles.

Trait	Watom		Tonga		Lakeba		Manus		Natunuku	
	n/N	%	n/N	%	n/N	%	n/N	%	n/N	%
Mandibular torus absent	6/6	100.0	2/2	100.0	2/2	100.0	2/2	100.0	2/2	100.0
Mylohyoid bridge no bridge	4/4	100.0	1/1	100.0	1/1	100.0			1/1	100.0
Multiple mandibular foramen absent	2/2	100.0	1/1	100.0	1/1	100.0			1/1	100.0
Multiple mental foramen absent	5/5	100.0	2/2	100.0	2/2	100.0	2/2	100.0	1/1	100.0
Rocker jaw none	1/4	25.0								
present	2/4	50.0								
partial anterior	1/4	25.0	1/1	100.0	2/2	100.0	1/1	100.0	1/1	100.0
Chin form median & angled inferiorly	2/4	50.0					1/1	100.0		
bilateral & angled inferiorly	1/4	25.0			2/2	100.0				
median, bilateral & angled inferiorly	1/4	25.0	1/1	100.0					1/1	100.0

Table 7. Descriptive statistics for tooth measurements, cross-sectional areas and tooth summary figures for Lapita dentitions (right & left sides combined).

Measurement	Watom			Tonga (Burial AK)		Natunuku			Manus			Combined			
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
UM3MD	3	8.0	0.8	0			0			0			3	8.0	0.8
UM3BL	3	10.3	0.8	0			0			0			3	10.3	0.8
UM2MD	4	10.2	1.0	0			1	10.1		0			5	10.2	0.9
UM2BL	4	11.7	0.4	0			1	12.3		0			5	11.9	0.4
UM1MD	3	10.3	0.3	0			0			0			3	10.3	0.3
UM1BL	3	12.0	0.5	0			0			0			3	12.0	0.5
UP4MD	3	6.1	0.6	0			0			0			3	6.1	0.6
UP4BL	3	9.5	0.6	0			0			0			3	9.5	0.6
UP3MD	3	6.4	0.7	0			0			0			3	6.4	0.7
UP3BL	3	9.7	0.3	0			0			0			3	9.7	0.3
UCMD	3	7.5	0.4	0			0			0			3	7.5	0.4
UCBL	3	8.5	0.2	0			0			0			3	8.5	0.2
ULIMD	3	6.7	0.7	0			0			0			3	6.7	0.7
ULIBL	3	6.6	0.7	0			0			0			3	6.6	0.7
UCIMD	3	8.7	0.1	1	7.4		0			0			4	8.4	0.7
UCIBL	3	7.1	0.5	1	7.9		0			0			4	7.3	0.6
UM3CX	3	81.6	8.1	0			0			0			3	81.6	8.1
UM2CX	4	120.5	13.3	0			1	124.2		0			5	121.3	11.7
UM1CX	3	122.8	3.0	0			0			0			3	122.8	3.0
UP4CX	3	57.6	2.1	0			0			0			3	57.6	2.1
UP3CX	3	62.3	4.8	0			0			0			3	62.3	4.8
UCCX	3	63.8	4.3	0			0			0			3	63.8	4.3
ULICX	3	44.7	8.6	0			0			0			3	44.7	8.6
UCICX	3	61.5	4.9	1	58.5		0			0			4	60.7	4.3
LM3MD	3	10.7	0.6	0			0			2	12.5	0.1	5	11.4	1.0
LM3BL	3	9.5	0.6	0			0			2	11.4	0.2	5	10.3	1.2
LM2MD	3	10.7	1.2	0			0			2	11.5	0.4	5	11.1	1.0
LM2BL	3	10.2	0.9	0			0			2	11.2	0.1	5	10.6	0.8
LM1MD	3	11.0	1.2	1	12.0		0			1	10.3		5	11.0	1.0
LM1BL	3	10.0	1.0	1	10.7		0			1	11.5		5	10.5	1.0
LP4MD	3	7.0	1.2	2	7.2	0.1	0			1	8.1		6	7.2	0.9
LP4BL	3	7.6	0.8	2	8.3	0.4	0			1	8.7		6	8.0	0.7
LP3MD	3	6.2	0.7	2	7.0	0.5	0			1	6.7		6	6.6	0.7
LP3BL	3	7.5	0.8	2	8.4	0.1	0			1	7.6		6	7.8	0.7
LCMD	3	6.3	0.3	2	6.8	0.2	2	6.9	0.6	2	7.0	0.4	9	6.7	0.4
LCBL	3	7.5	0.2	2	7.7	0.1	2	7.8	0.2	2	7.8	0.2	9	7.7	0.2
LLIMD	3	5.7	0.5	0			2	5.6	0.1	1	5.2		6	5.6	0.4
LLIBL	3	5.4	0.6	0			2	6.1	0.0	1	7.0		6	5.9	0.7
LCIMD	2	4.5	0.0	0			0			0			2	4.5	0.0
LCIBL	2	5.4	0.6	0			0			0			2	5.4	0.6
LM3CX	3	102.0	9.1	0			0			2	143.1	4.3	5	118.5	23.5
LM2CX	3	110.0	20.3	0			0			2	129.9	4.8	5	118.0	18.2
LM1CX	3	110.8	23.3	1	128.4		0			1	118.4		5	115.9	18.2
LP4CX	3	53.6	15.5	2	59.8	4.2	0			1	70.5		6	58.5	11.9
LP3CX	3	46.7	10.6	2	59.3	5.2	0			1	50.9		6	51.6	9.4
LCCX	3	47.0	1.9	2	53.1	1.2	2	54.2	5.9	2	55.4	4.3	9	51.8	4.6
LLICX	3	30.9	4.8	0			2	34.2	0.9	1	36.4		6	32.9	3.9
LCICX	2	24.3	2.5	0			0			0			2	24.3	2.5
TS	1	1140		0			0			0			1	1186	

Table 8. Incidence of dental non-metric traits recorded in male Lapita-associated dentitions.

Trait	Watom		Tonga		Manus		Total	
	n/N	%	n/N	%	n/N	%	n/N	%
Shovel-shaped incisors								
maxillary	5/6	83.3					5/6	83.3
mandibular	0/5	0.0					0/5	0.0
Peg-shaped teeth	0/53	0.0	0/9	0.0	0/11	0.0	0/73	0.0
Molar and premolar enamel extension								
absent	31/31	100.0	4/5	80.0	7/7	100.0	42/43	97.7
present			1/5	20.0			1/43	2.3
Protostylid cusp								
absent	11/12	91.7	1/1	100.0	6/6	100.0	18/19	94.7
present	1/12	8.3					1/19	5.3
Carabelli's cusp								
absent	10/10	100.0					10/10	100.0
present								
Maxillary molar cusp pattern								
M 3								
3	2/3	66.7					2/3	66.7
3+	1/3	33.3					1/3	33.3
M 2								
3+	1/2	50.0					1/2	50.0
4-	1/2	50.0					1/2	50.0
M 1								
3+	1/3	33.3					1/3	33.3
4	2/3	66.7					2/3	66.7
Mandibular molar cusp pattern								
M 3								
+4	2/3	66.7					2/3	66.7
Y4	1/3	33.3					1/3	33.3
M 2								
+4	4/4	100.0					4/4	100.0
M 1								
+4	1/2	50.0					1/2	50.0
Y5	1/2	50.0					1/2	50.0

Table 9. Incidence of premortem and postmortem tooth loss in Watom and other Lapita teeth.

	Watom		Tonga		Manus			
	Premortem n/N	%	Premortem n/N	%	Premortem n/N	%	Postmortem n/N	%
Maxillary								
M 3	1/4	25.0	—	—	—	—	—	—
M 2	0/3	0.0	1/1	100.0	—	—	—	—
M 1	0/4	0.0	0/1	0.0	—	—	—	—
P 4	0/3	0.0	0/2	0.0	—	—	—	—
P 3	0/3	0.0	0/2	0.0	—	—	—	—
C	0/3	0.0	0/2	0.0	—	—	—	—
I 2	0/3	0.0	0/2	0.0	—	—	—	—
I 1	0/3	0.0	0/2	0.0	—	—	—	—
Total M+P	1/17	5.9	1/6	16.7	—	—	—	—
Total C+I	0/9	0.0	0/6	0.0	—	—	—	—
Total	1/26	3.8	1/12	8.3	—	—	—	—
Mandibular								
M 3	0/4	0.0	2/2	100.0	0/1	0.0	0/1	0.0
M 2	0/4	0.0	2/2	100.0	0/2	0.0	0/2	0.0
M 1	0/4	0.0	1/2	50.0	0/2	0.0	0/2	0.0
P 4	0/4	0.0	0/2	0.0	0/1	0.0	0/1	0.0
P 3	1/4	25.0	0/2	0.0	1/1	100.0	0/1	0.0
C	1/4	25.0	0/2	0.0	0/1	0.0	1/1	100.0
I 2	1/4	25.0	1/1	100.0	0/2	0.0	1/2	50.0
I 1	2/4	50.0	—	—	0/2	0.0	2/2	100.0
Total M+P	1/20	5.0	5/10	50.0	1/7	14.3	0/7	0.0
Total C+I	4/12	33.3	1/3	33.3	0/5	0.0	4/5	80.0
Total	5/32	15.6	6/13	46.2	1/12	8.3	4/12	33.3

Table 10. Frequency of periodontal disease in Lapita-associated dental remains.

Trait	Watom		Tonga		Manus		Total	
	n/N	%	n/N	%	n/N	%	n/N	%
Calculus buildup								
absent					1/11	9.1	1/72	1.4
slight	34/52	65.4	9/9	100.0	5/11	45.5	48/72	66.7
moderate	17/52	32.7			5/11	45.5	22/72	30.5
marked	1/52	1.9					1/72	1.4
Resorption								
slight	3/48	6.3					3/69	4.3
moderate	39/48	81.3	15/15	100.0	6/6	100.0	60/69	87.0
marked	6/48	12.5					6/69	8.7
Rolled rim								
absent	2/41	4.9					2/41	4.9
slight	25/41	61.0					25/41	61.0
moderate	14/41	34.1					14/41	34.1

Table 11. Incidence of dental pathology in Lapita-associated dentitions.

Trait	Watom		Tonga		Manus		Total	
	n/N	%	n/N	%	n/N	%	n/N	%
Hypoplasia								
absent	50/52	96.2	9/9	100.0	11/11	100.0	70/72	97.2
slight	2/52	3.8					2/72	2.8
Caries								
absent	52/52	100.0	2/14	14.3	11/11	100.0	65/77	84.4
present			12/14	85.7			12/77	15.6
Abscessing								
absent	42/42	100.0	14/16	87.5	10/11	90.9	66/69	95.7
present			2/16	12.5	1/11	9.1	3/69	4.3
Attrition								
enamel	31/52	59.6					31/79	39.2
dentin	21/52	40.4	9/16	56.3	10/11	90.9	40/79	50.6
pulp			1/16	6.2			1/79	1.3
roots			6/16	37.5	1/11	9.1	7/79	8.9

Table 12. Descriptive statistics for measurements recorded in Lapita-associated infracranial skeletons from Watom Island.

Bone/Measurement	N	Left		N	Right	
		Mean	S.D.		Mean	S.D.
Clavicle						
Max. length	1	136.0		1	136.0	
Sag. diam. mid-shaft	3	11.0	1.0	3	11.7	1.5
Vertical (cranial-caudal) diam. (mid)	4	9.3	1.3	3	9.3	0.6
Circumference at mid-shaft	4	37.8	6.0	3	35.0	3.6
Humerus						
Max. length	2	337.5	17.5	1	303.0	
Max. head diam. (a-p)	2	45.0	1.4	1	42.0	
Min. head diam. (trans.)	2	40.5	3.5	1	37.0	
Epicondylar breadth	3	58.7	5.9	1	61.0	
Mid-circumference	3	70.0	4.4	3	71.3	3.5
Max. diam. mid-shaft	3	23.0	1.7	3	23.0	1.0
Min. diam. mid-shaft	3	18.7	1.2	3	19.0	1.0
Least circum. (distal to deltoid)	2	64.5	3.5	3	69.0	1.7
Radius						
Max. length	1	286.0		2	266.0	29.7
Radial head diam.	1	20.0		2	21.5	0.7
Sagittal diam. mid-shaft	3	11.0	1.0	3	11.7	1.5
Transverse diam. mid-shaft	3	14.0	1.0	3	16.3	1.5
Ulna						
Maximum length	1	305.0				
Dorso-volar diam. (max.)	2	16.5	0.7	2	17.5	2.1
Trans. diam. (perpend. to latter)	2	11.5	2.1	2	12.0	1.3
Min. circum. (near distal end)	2	33.0	2.8	2	36.0	1.4

Table 12 (cont'd).

Bone/Measurement	N	Left		N	Right	
		Mean	S.D.		Mean	S.D.
Femur						
Maximum length	1	452.0		1	466.0	
Bicondylar (physiological) length						
Epicondylar breadth	1	75.0		1	73.0	
Max. hd. diam.	2	44.0	4.2	3	44.0	3.5
Subtrochanteric (a-p) diam.	4	28.5	4.8	6	26.5	2.3
Subtrochanteric (trans.) diam.	4	33.0	6.7	6	29.8	2.1
Mid-shaft (a-p) diam.	4	29.0	3.9	6	29.7	2.4
Mid-shaft (trans.) diam.	4	24.3	2.6	6	25.0	1.3
Circum. mid-shaft	4	88.0	8.1	6	88.2	6.0
Tibia						
Max. length						
Max. epip. breadth-prox.						
Max. epip. breadth-distal						
Max. diam. at nutrient for.	2	32.5	0.7	2	33.5	3.5
Trans. diam. at nutrient for.	2	23.5	0.7	2	22.5	2.1
Circumference at nutrient for.	2	91.5	2.1	2	89.5	6.4
Mid-shaft a-p diam.	2	29.0	1.4	2	26.0	5.7
Mid-shaft trans. diam.	2	19.0	1.4	1	22.0	
Fibula						
Max. length	1	371.0				
Max. diam. at mid-shaft	1	42.0		1	46.0	
Patella						
Height	2	41.0	2.8	4	40.3	1.0
Width	4	40.5	1.0	4	41.3	2.4
Thickness	5	19.0	1.9	4	19.0	0.8
Calcaneus						
Max. length	2	76.5	3.5	3	78.3	1.2
Max. breadth	2	40.0	0.0	3	42.0	1.7
Talus						
Max. length	5	52.2	3.3	5	52.2	2.7
Max. breadth	4	39.8	1.9	5	39.4	2.7
Lumbar (ht. of centrum)						
Lumbar 1.			Post.		Ant.	
Lumbar 2.	1	26.0		1	23.0	
Lumbar 3.						
Lumbar 4.						
Lumbar 5.						

Table 13. Summary of estimated statures for Watom burials.

Burial No.	Sex	Age (yrs.)	Stature		Bone or segment length	Houghton <i>et al.</i> (1975) formula No.
			(cm.)	(ft.,in)		
1	F	30	164	5'5"	R. femur Seg.1 (7.7 cm)	1
2	F	19	154.7	5'1"	L. femur Seg.2 (21.1 cm)	7
3	M	30-40	176.2	5'9"	R. femur Seg.4 (3.9 cm)	1
4	M	35	170	5'7"	R. femur Seg.2 (23.5 cm)	1
5	M	30	173.7	5'8"	L. humerus (32.5 cm)	10
6	M	30-35	180	5'11"	L. humerus (35.0 cm)	10
7	M	Adult	172.7	5'8"	R. femur Seg.2 (24.8 cm)	1
8	M	Adult	171.9	5'7"	L. tibia Seg.3 (13.6 cm)	8

Table 14. Infracranial indices for Watom and Lapita male skeletal remains.

Index	Side:	Watom		Burial AK		Natunuku		Combined	
		L	R	L	R	L	R	L	R
Humeral robusticity	N/N	3/2 20.7	3/1 23.5					3/2 20.7	3/1 23.5
Humeral diaphyseal	N/N	3/3 81.3	3/3 82.6	1/1 95.2	1/1 90.5			4/4 84.4	5/5 85.7
Radio-humeral	N/N	1/2 84.7	2/1 87.8					1/2 84.7	2/1 87.8
Femur robusticity	N/N	4/1 11.8	6/1 11.7			1/1 12.5	1/1 12.8	6/2 12.1	7/2 12.1
Humeral-femur	N/N	2/1 74.7	1/1 65.0					2/1 74.7	1/1 65.0
Crural	N/N						1/1 88.7		1/1 88.7
Tibia-thickness	N/N	2/2 65.5	1/2 84.6	1/1 64.5		1/1 64.5	1/1 66.7	4/4 65.0	2/3 77.7
Platymeric	N/N	4/4 84.8	6/6 88.9	1/1 78.1		1/1 81.2	1/1 81.2	6/6 84.1	7/7 87.7
Pilastric	N/N	4/4 119.3	6/6 118.8	1/1 123.1		1/1 124.0	1/1 128.0	6/6 120.6	7/7 120.0
Platynemic	N/N	2/2 72.3	2/2 67.2	1/1 61.1		1/1 67.6	1/1 63.9	4/4 68.0	3/3 66.2
Patella module	N/N	2-5 33.5	4 33.5		1 33.6			5-6 33.7	5 33.5

Table 15. Summary of non-metric traits recorded in the infracranial skeletons from Watom Island and Tonga (sides and sexes combined).

Trait and Variation	Watom		Burial AK		Total	
	n/N	%	n/N	%	n/N	%
Clavicle						
Costoclavicular sulcus						
present	5/6	83.3	1/1	100.0	6/7	85.7
ridge	1/6	16.7			1/7	14.3
Supraclavicular foramen						
absent	5/7	71.4			5/7	71.4
present	2/8	28.6			2/7	28.6
Humerus						
Supratrochlear notch						
absent	4/4	100.0	2/2	100.0	6/6	100.0
Septal aperture						
absent	2/3	66.7	3/3	100.0	5/6	83.3
present	3/3	33.3			1/6	16.7
Ulna						
Trochlear notch shape						
indented	1/3	100.0	2/3	66.7	5/6	83.3
island			1/3	33.3	1/6	16.7
Innominate						
Acetabular notch						
absent	1/1	100.0			1/1	100.0
Pre-auricular sulcus GP						
absent	4/5	80.0			4/5	80.0
present	1/5	20.0			1/5	20.0
Pre-auricular sulcus GL						
absent	3/5	60.0			3/5	60.0
present	2/5	40.0			2/5	40.0
Femur						
Fossa of Allen						
absent	2/3	66.7			2/3	66.7
ulcer	1/3	33.3			1/3	33.3
Third trochanter						
ridge	3/3	100.0	1/1	100.0	4/4	100.0
Fovea capitis shape						
round	2/5	40.0			2/5	40.0
oval	3/5	60.0			3/5	60.0
Patella						
Vastus facet						
absent	2/12	16.7			3/14	21.4
present	10/12	83.3	1/1	100.0	11/14	78.6
Vastus notch						
absent	13/13	100.0	1/1	100.0	14/15	93.3
present					1/15	6.7
Patellar spurs						
absent	7/13	53.8	1/1	100.0	8/14	57.2
present	6/13	46.2			6/14	42.8
Tibia						
Anterior squatting facet						
present	2/2	100.0	1/1	100.0	3/3	100.0

Table 15 (cont'd).

Trait and Variation	Watom		Burial AK		Total	
	n/N	%	n/N	%	n/N	%
Talus						
Talar extension						
absent			1/1	100.0	1/8	12.5
medial extension	5/7	71.4			5/8	62.5
med. & lat. ext.	2/7	28.6			2/8	25.0
Squatting facet						
absent	1/13	7.7			1/14	7.1
medial	2/13	15.4			2/14	14.3
neck	10/13	76.9			10/14	71.4
med. & lat. facet			1/1	100.0	1/14	7.1
Calcaneus						
Calcaneal facet						
two	5/9	55.6			5/9	55.6
hour-glass	4/9	44.4			4/9	44.4
Peroneal tubercle						
absent	3/5	60.0			3/5	60.0
present	2/5	40.0			2/5	40.0

Table 16. Summary of non-metric variation recorded in the vertebrae from Watom Island and Tonga (Burial AK) (sexes and sides combined).

	Watom		Burial AK		Total	
	n/N	%	n/N	%	n/N	%
Atlas Vertebra (C-1)						
Foramen transversarium						
normal	1/1	100.0			1/1	100.0
R:L foramen transversarium						
R > L	1/1	100.0			1/1	100.0
Bridging to sup. art. facet						
none or normal	8/8	100.0			8/8	100.0
Atlas bridging						
none or normal	8/8	100.0			8/8	100.0
Incomplete costal bar						
normal or complete	6/6	100.0			6/6	100.0
Spina bifida						
absent	2/2	100.0			2/2	100.0
Shape sup. articular facet						
single	2/8	25.0			2/8	25.0
constricted	6/8	75.0			6/8	75.0
Axis Vertebra (C-2)						
Apical process						
absent or normal	4/4	100.0	1/1	100.0	5/5	100.0
Foramen transversarium						
normal	2/2	100.0	1/1	100.0	3/3	100.0
Spina bifida						
none	2/2	100.0	1/1	100.0	3/3	100.0
Cervical Vertebrae 3-7						
Foramen transversarium						
normal	1/2	50.0	3/3	100.0	4/5	80.0
two	1/2	50.0			1/5	20.0
Spinous process						
none	1/1	100.0	1/1	100.0	2/2	100.0
Spina bifida						
none	4/4	100.0	1/1	100.0	5/5	100.0
Thoracic Vertebrae 1-12						
Laminal spurring						
absent	6/7	85.7			6/7	85.7
present	1/7	14.3			1/7	14.3
Spina bifida						
none	15/15	100.0			15/15	100.0
Lumbar Vertebrae 1-5						
Laminal spurring						
absent	5/5	100.0			5/5	100.0
Spina bifida						
none	10/10	100.0			10/10	100.0
Spondylolysis						
normal	5/5	100.0			5/5	100.0
Sacral Vertebrae						
Inferior sacral hiatus						
S-4/S-3	1/1	100.0			1/1	100.0

Table 17. Summary of incidence of osteoarthritis in the appendicular skeletons from Watom Island and Tonga (Burial AK) (right and left sides combined).

Articular Surface (Severity)	Watom		Burial AK		Total	
	n/N	%	n/N	%	n/N	%
Sterno-clavicular none	3/3	100.0	1/1	100.0	4/4	100.0
Acromio-clavicular none	2/2	100.0			2/2	100.0
Glenoid cavity none	5/6	83.3			5/8	62.5
slight	1/6	16.7	2/2	100.0	3/8	37.5
Humeral head none	2/2	100.0			2/2	100.0
Capitulum none	6/6	100.0			6/8	75.0
slight			2/2	100.0	2/8	25.0
Trochlea none	7/7	100.0			7/9	77.8
slight			2/2	100.0	2/9	22.2
Radial head none	4/4	100.0			4/5	80.0
medium			1/1	100.0	1/5	20.0
Distal radius none	4/4	100.0			4/6	66.7
slight			2/2	100.0	2/6	33.3
Proximal ulna none	4/7	57.1			4/9	44.5
slight	3/7	42.9			3/9	33.3
medium			2/2	100.0	2/9	22.2
Distal ulna none	3/3	100.0	1/1	100.0	4/4	100.0
Sacroiliac joint slight	3/3	100.0	1/1	100.0	4/4	100.0
Acetabulum none	6/8	75.0			6/9	66.7
slight	2/8	25.0	1/1	100.0	3/9	33.3
Femoral head none	5/6	83.3	1/1	100.0	6/7	85.7
slight	1/6	16.7			1/7	14.3
Femoral condyles none	4/5	80.0			4/6	66.7
slight	1/5	20.0	1/1	100.0	2/6	33.3
Patella none	6/11	54.5			6/12	50.0
slight	5/11	45.5	1/1	100.0	6/12	50.0
Distal tibia none	2/3	66.7	1/2	50.0	3/5	60.0
slight	1/3	33.3	1/2	50.0	2/5	40.0

Table 17 (cont'd).

Articular Surface (Severity)	Watom		Burial AK		Total	
	n/N	%	n/N	%	n/N	%
Proximal fibula none	1/1	100.0			1/1	100.0
Distal fibula none	4/4	100.0			4/5	80.0
			1/1	100.0	1/5	20.0
Calcaneus none	4/10	40.0			4/11	36.4
	6/10	60.0	1/1	100.0	7/11	63.6
Talus none	7/15	46.7			7/16	43.8
	8/15	53.3	1/1	100.0	9/16	56.2
Tarsals none	4/14	28.6	2/2	100.0	6/16	37.5
	10/14	71.4			10/16	62.5
Carpals none	7/11	63.6	1/2	50.0	8/13	61.5
	4/11	36.4	1/2	50.0	5/13	38.5
Metatarsals none	5/10	50.9			5/12	41.7
	5/10	50.0	2/2	100.0	7/12	58.3
Metacarpals none	6/12	50.0			6/14	42.9
	6/12	50.0	2/2	100.0	8/14	57.1
Hand phalanges none	10/12	83.3	2/2	100.0	12/14	85.7
	2/12	16.7			2/14	14.3
Foot phalanges none	8/10	80.0	2/2	100.0	10/12	83.3
	2/10	20.0			2/12	16.7

Table 18. Mandibular indices for Lapita and Asian-Pacific samples.

Group	Mandibular Index	Gonio-Condylar Index	Ramus Index
Watom	69.1	77.7	69.2
Lakeba	—	—	—
Burial AK	—	—	67.2
Manus	—	—	—
Natunuku	94.7	87.7	55.0
Combined Lapita	81.9	82.7	66.0
Fiji	94.0	83.9	57.6
Tonga	87.3	80.1	56.4
Namu	82.6	80.6	52.3
Wairau Bar	90.6	70.8	56.0
New Zealand	83.0	88.5	52.9
Society Is.	89.2	81.3	58.9
Marquesas	91.8	83.8	57.2
Easter Is.	86.1	79.2	63.8
Hawaii	85.7	82.7	54.0
E. Micronesia	94.7	87.0	57.5
Guam	88.7	85.1	58.2
Gulf of Papua	93.8	82.4	50.9
New Britain	90.6	83.0	54.8
New Ireland	92.0	81.5	53.0
New Caledonia	—	82.6	60.2
Loyalty	—	85.0	60.6
Vanuatu	—	80.4	54.9
China	—	83.6	55.9
South-east Asia	—	82.9	55.9
Thailand	—	82.7	53.4
Java	83.0	82.7	54.0
Sulu	—	83.2	54.6
Western Australia	—	83.4	53.5

Table 19. A comparison of non-metric variation in mandibles¹.

Sample	Trait		
	Mylo-hyoid bridge	Multiple mental foramen	Rocker jaw
Watom	0/4	0/2	3/4
	0.0	0.0	75.0
Lapita	0/7	0/5	8/9
	0.0	0.0	88.9
Polynesia	18/234	20/241	107/126
	7.7	8.3	89.2
Tonga	5/36	0/28	11/18
	13.9	0.0	61.1
Fiji	5/22	0/11	7/10
	22.7	0.0	70.0
E. Melanesia	9/173	22/191	52/94
	5.2	11.5	55.3
Bismarck Arch.	19/201	34/204	58/96
	9.4	16.7	60.4
Papua	1/165	13/160	74/78
	0.6	8.1	94.9
E. Asia	2/141	17/178	62/89
	1.4	9.6	69.7
S.E. Asia	4/112	9/114	35/52
	3.6	7.9	67.3
Island S.E. Asia	19/350	31/358	138/177
	5.4	8.7	78.0

¹The comparative data are taken from Pietruszewsky (1977, 1984). The frequencies represent pooled information.

Table 20. A comparison of tooth summary figures for Lapita and selected Pacific and circum-Pacific samples.

	Tooth Summary Figure
China	1157
Watom Is.	1140
Lapita (combined)	1186
Chatham Island	1181
Borneo	1190
Hawaii	1200
Japan	1200
Marquesas	1204
Thailand	1233
Northern Marianas	1238
Java	1240
New Caledonia	1256
New Ireland	1266
North Coast Papua New Guinea	1286
Philippines	1288
Vanuatu	1295
Guam	1309
Samoa	1311
Sepik R.	1321
New Britain	1334
Fiji	1338
Bougainville	1359
Tonga	1371
Eastern Highlands Papua New Guinea	1395
Tasmania	1429
Murray River, Australia	1486

Table 21. A comparison of infracranial indices and stature for Lapita and Pacific Island male samples.

	Watom	Natunuku	Burial AK	Lapita	Fiji	Nebira	Tonga	Hawaii	New Zealand	Easter Island	Marquesas
Crural Index		88.7		88.7	84.2	84	83.5	84	82.4	83.7	82
Pilastric	119	124	123	120.6	133.7	121	116.9	115	116.7	115.8	122.2
Platymeric	84.8	81.2	78.1	84.1	94.5	82	84.8	71	65	72.7	76.5
Femoral robust.	11.8	12.5		12.1	13.1	13.5	12.6	14.6	12.4	12.0	13.3
Platycnemic	72/67*	67/64*	61	68	66.7	65	66.1	66		71.8	69.4
Humeral-femur	76/65*		74.4	72.5	70	70.3	72	71.8	71.2	72.9	
Stature	174	173	174		169	167	176	173	171	173	174

*Values are expressed for both sides: right/left.

Table 22. Means and standard deviations for 22 mandibular measurements for 7 male samples.

Measurement	Tonga (15)		Namu (16)		New Zealand (26)		Chatham Island (7)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
MANDLNTH	110.3	4.3	99.2	3.3	99.7	5.0	102.3	3.7
INFMANDL	64.8	5.9	63.8	4.0	64.1	5.2	65.3	4.4
ALVEOLGT	59.9	2.8	58.8	4.0	57.1	3.3	57.1	4.4
BICONDWH	123.5	8.5	120.8	3.0	123.4	8.4	127.1	5.6
MIDCONDW	105.1	6.4	102.1	2.2	102.7	7.6	102.1	5.7
BIGONIAL	99.0	7.2	97.6	4.6	103.5	5.8	112.6	5.0
BICANBTH	34.7	1.8	32.4	1.9	32.5	2.1	34.4	1.5
FRMOLBTH	64.9	2.8	61.9	3.6	59.6	3.4	62.3	2.8
THMOLBRH	73.6	3.3	71.1	3.9	68.6	3.9	72.4	3.5
SYMPHYHT	30.3	2.5	30.2	2.2	33.8	2.8	37.4	1.8
MENFORHT	30.3	3.0	30.3	2.3	32.8	2.6	36.0	1.7
CANINEHT	30.9	2.9	30.9	2.6	33.3	2.4	36.9	1.3
MOLARHT	28.5	3.6	28.3	2.6	31.9	3.1	32.3	2.1
SYMPHYBH	14.1	1.6	14.4	1.8	14.2	1.9	16.6	1.1
MENFORBH	11.7	0.8	10.9	1.8	12.3	1.7	12.9	0.7
CANINEBH	11.7	0.8	11.5	1.6	12.3	1.8	12.6	1.3
MOLARBTH	13.4	1.6	12.6	2.1	14.3	1.7	13.7	1.6
RAMUSHGT	63.2	7.8	68.2	5.9	68.5	5.9	71.6	2.1
RAMUSBTH	37.3	4.4	34.8	3.6	36.3	3.7	37.9	2.4
CONDYLG	11.2	0.9	10.1	0.7	12.4	1.8	12.6	1.5
CONDBTH	21.5	2.1	22.6	1.3	23.5	1.9	24.7	2.6
MONETWO	20.9	1.4	23.2	1.3	20.8	1.9	20.7	1.5
	Wairau Bar (5)		Northern Marianas (10)		Lapita (7)			
Measurement	Mean	S.D.	Mean	S.D.	Mean	S.D.		
MANDLNTH	113.4	4.5	108.3	3.7	98.1	5.0		
INFMANDL	65.6	4.8	63.2	4.1	64.1	6.5		
ALVEOLGT	58.4	4.2	60.5	4.2	60.3	7.5		
BICONDWH	121.8	17.3	126.5	6.7	126.9	7.2		
MIDCONDW	113.4	4.0	108.9	5.7	123.0	0.0		
BIGONIAL	101.8	5.5	107.7	4.4	101.1	3.3		
BICANBTH	33.0	1.4	34.4	2.6	33.7	2.1		
FRMOLBTH	60.6	1.8	62.7	2.3	61.9	3.5		
THMOLBTH	72.4	2.4	72.7	3.1	73.0	4.4		
SYMPHYHT	35.2	2.3	33.2	1.8	29.1	3.3		
MENFORHT	34.0	3.0	33.0	2.2	27.9	4.3		
CANINEHT	35.6	2.9	33.8	1.6	28.6	3.6		
MOLARHT	32.2	1.8	29.8	2.9	27.6	1.3		
SYMPHYBH	14.4	1.1	15.4	1.3	13.9	1.5		
MENFORBH	12.2	1.3	14.9	1.1	11.1	1.1		
CANINEBH	12.0	1.2	13.8	1.2	11.4	1.0		
MOLARBTH	14.8	0.8	15.3	1.4	13.7	1.1		
RAMUSHGT	68.8	2.8	66.2	5.3	61.9	6.3		
RAMUSBTH	39.0	1.6	38.0	2.4	38.9	5.0		
CONDYLG	11.8	2.4	11.3	0.8	10.9	0.4		
CONDBTH	24.4	1.5	22.3	1.8	19.9	1.5		
MONETWO	21.8	0.8	22.9	1.3	21.3	1.9		

Table 23. A ranking of mandibular measurements for 7 male samples, according to F-values obtained in the final step of stepwise discriminant function analysis.

Step No.	Measurement	F-Value	d.f.B/d.f.W	P*
1	MANDLNTH	20.4	6/86	*
2	MIDCONDW	15.5	6/85	*
3	SYMPHYHT	13.8	6/84	*
4	BICONDWH	8.6	6/83	*
5	MENFORBH	6.0	6/82	*
6	MONETWO	5.5	6/81	*
7	CONDBTH	5.1	6/80	*
8	BIGONIAL	4.2	6/79	*
9	CONDYLG	2.7	6/78	*
10	MOLARBTH	2.3	6/77	*
11	FRMOLBTH	1.9	6/76	NS
12	RAMUSBTH	2.2	6/75	NS
13	MOLARHT	1.7	6/74	NS
14	MENFORHT	3.1	6/73	*
15	SYMPHYBH	2.0	6/72	NS
16	RAMUSHBT	1.4	6/71	NS
17	THMOLBTH	1.2	6/70	NS
18	BICANBTH	1.0	6/69	NS
19	CANINEHT	0.7	6/68	NS
20	INFMANDL	0.6	6/67	NS
21	ALVEOLGT	0.4	6/66	NS
22	CANINEBH	0.6	6/65	NS

* = P<.01

NS = not significant

Table 24. Eigenvalues, percentage of total dispersion, cumulative percentage of dispersion and level of significance for the canonical variables.

Variable	Eigenvalue	% Dispersion	Cumulative % Dispersion	d.f. ¹	P ²
I	4.59870	36.1	36.1	27	*
II	3.19327	24.9	61.0	25	*
III	2.19804	17.3	78.3	23	*
IV	1.26450	9.9	88.2	21	*
V	0.82056	6.4	94.6	19	*
VI	0.68878	5.4	100.0	17	*

¹ d.f.= degrees of freedom = (p+q-2) (p+q-4)...² P <.01 when eigenvalues are tested for significance according to Bartlett's criterion: $\{N-1/2(p+q) \log_e(1+x)\}$, where N = total number of crania, p = number of variables, q= number of groups, x = eigenvalues, which are distributed approximately as chi-square (Rao, 1952:373).

Table 25. Canonical coefficients for mandibular measurements recorded in 7 male samples for the first 2 canonical variables arranged in decreasing order.

Canonical Variable I		Canonical Variable II	
Variable	Coefficient	Variable	Coefficient
CONDBTH	0.30736	MOLARBTH	0.32176
MIDCONDW	-0.18380	CONDYLG	0.28552
RAMUSBTH	-0.12540	MONETWO	-0.28423
MANDLNTH	-0.11775	MOLARHT	0.25685
MENFORHT	0.11474	SYMPHYBH	-0.17818
SYMPHYHT	0.10116	MANDLNTH	-0.16665
MOLARHT	-0.07116	MIDCONDW	0.16531
CONDYLG	0.06693	FRMOLBTH	-0.15845
RAMUSHGT	0.06197	SYMPHYHT	0.15420
CANINEBH	-0.05052	MENFORBH	-0.13438
BIGONIAL	0.04761	CANINEHT	-0.12143
ALVEOLGT	0.03799	CANINEBH	-0.11981
BICONDWH	0.03310	MENFORHT	-0.08260
BICANBTH	-0.03049	BIGONIAL	0.08234
MONETWO	-0.02651	BICONDWH	-0.07880
INFMANDL	-0.02285	RAMUSBTH	-0.07229
MENFORBH	0.02156	ALVEOLGT	0.06288
SYMPHYBH	0.02130	CONDBTH	-0.05067
THMOLBTH	-0.01193	THMOLBTH	0.04269
MOLARBTH	-0.00394	BICANBTH	0.02507
CANINEHT	0.00272	INFMANDL	-0.01547
FRMOLBTH	0.00203	RAMUSHGT	-0.00736

Table 26. Summary of classification results from stepwise discriminant function analysis for 7 male samples (number of cases classified in groups).

Group	NZ	TOG	CHT	NAM	NMR	WAI	LAP
New Zealand	24				1		
Tonga		14			1		
Chatham Island			7				
Namu				16			
Northern Marianas					10		
Wairau Bar	1					4	
Lapita							7
Total Cases							
Orig. Assign.	25	15	7	16	10	5	7
No. Cases							
Correctly Assign.	24	14	7	16	10	4	7
% Correct. Assign.	96	93.3	100	100	100	80	100

Table 27. Mahalanobis' generalised distances for 7 male samples using 6 mandibular measurements.

Group	NZ	TOG	CHT	NAM	NMR	WAI	LAP
New Zealand	–	10.879	2.612	5.939	11.238	20.958	28.758
Tonga		–	16.829	10.390	7.515	12.710	29.679
Chatham Is.			–	13.131	15.167	25.039	42.697
Namu				–	14.502	25.759	29.534
Northern Marianas					–	10.658	28.489
Wairau Bar						–	18.856
Lapita							–

Table 28. Means and standard deviations for 4 mandibular measurements for 8 male samples*.

Group	(N)	BIGONIAL		SYMPHYHT		RAMUSHGT		RAMUSBTH	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Polynesia	135	101.7	6.6	32.7	3.3	65.2	7.0	36.8	3.8
E. Melanesia	95	98.2	6.9	31.9	3.5	66.1	5.5	38.3	4.3
Is. S.E. Asia	50	98.7	5.7	32.3	2.5	63.3	5.5	34.3	2.3
S.E. Asia	93	100.5	6.4	32.2	3.0	63.9	5.6	34.7	3.2
E. Asia	38	100.3	6.0	34.2	4.9	62.3	4.9	34.7	2.1
Papua	30	95.0	4.9	30.1	3.8	62.8	8.0	32.2	2.4
Bismarck	46	97.5	6.4	30.8	3.8	66.2	6.0	36.1	3.5
Lapita	7	101.1	3.3	29.1	3.3	61.9	6.3	38.9	5.0

* The samples contain the following cranial series: Polynesia = Namu – 9, Tonga – 16, Tahiti – 14, Marquesas – 9, Easter Is. – 14, Chatham Is. – 10, New Zealand – 33, Hawaii – 30; E. Melanesia = Fiji – 9, Loyalty – 21, New Caledonia – 30, Vanuatu – 35; Is. South-east Asia = Java – 26, Sulu – 18, Philippines – 6; South-east Asia – Thailand – 59, Vietnam, Laos & Cambodia – 34; East Asia = China – 32, Japan – 6; Papua = Gulf – 12, Purari Delta – 9, Sepik R. – 9; Bismarck = New Ireland – 9, New Britain – 37; Lapita = Watom (Nos. 3,6, & M2) – 3, and one specimen each from Tonga, Manus, Natunuku, and Lakeba.

Table 29. A ranking of mandibular measurements for 8 male samples according to F-values obtained in the final step of stepwise discriminant function analysis.

Step No.	Measurement	F-Value	d.f. _B /d.f. _w	P*
1	RAMUSBTH	17.2	7/494	*
2	SYMPHYHT	7.9	7/493	*
3	BIGONIAL	4.9	7/492	*
4	RAMUSHGT	3.0	7/491	*

* p <.01.

Table 30. Eigenvalues, percentage of total dispersion, cumulative percentage of dispersion and level of significance for the canonical variables.

Variable	Eigenvalue	% Dispersion	Cumulative % Dispersion	d.f. ¹	P ²
I	0.28943	59.3	59.3	10	*
II	0.14584	29.9	89.2	8	*
III	0.03638	7.5	96.7	6	*
IV	0.01618	3.3	100.0	4	*

¹ d.f. = degrees of freedom = (p+q-2) (p+q-4)...

² P <.01 when eigenvalues are tested for significance according to Barlett's criterion: $\{N-1/2(p+q)\log_e(1+x)\}$, where N = total number of crania, p = number of variables, q=number of groups, x = eigenvalues, which are distributed approximately as chi-square (Rao, 1952:373).

Appendix C

Miscellaneous remains from Watom Island.

Explanation of information presented.

Year: The year the material was excavated, either 1966 or 1985.

Rectangle: The main Watom burials come from Rectangles I, III, IV at Site SAC(8).

Square: These apply only to the 1985 excavations and follow the scheme adopted by Green & Anson.

Notes: This refers to the information which accompanied the miscellaneous remains; for the most part it was copied verbatim from the information written on the bags containing these remains.

Bones: This is an inventory of the human dental and skeletal remains which were identified in each bag of miscellaneous material.

Animal: If animal remains were identified in these bags, they were noted here.

Cultural: Any cultural material identified in these remains was noted.

Data Collected: If any information, measurements or other observations, were made, they were entered here.

Assignment: If any of the human remains found among the miscellaneous material could be assigned to one of the eight major burials, it was noted here.

Comments: Any other observations regarding the miscellaneous remains were noted here.

Year: 1966

Rectangle: I

Square:

Notes: Misc. material from Burials 1, 2, ?4-leg bones.

Bones: Upper limb fragments and a plastic vial containing a single adult human (upper left?) canine.

Animal:

Cultural:

Data collected: Canine tooth: MD = 9.0 mm, BL = 9.1 mm, slight wear, no caries, calculus or hypoplasia.

Assignment: None.

Comments: Upper limb fragments too incomplete for further analysis.

Year: 1966

Rectangle: I

Square:

Notes: Misc. material from Burials 1, 2, ?4 – metatarsals, metacarpals, phalanges.

Bones: Left talus, left cuneiforms 1 and 3, left distal fibula fragment, right MT-1 and phalanges, right cuneiforms 1 and 2; probably from same Burial (No.1). Two right fifth metatarsals, two proximal phalanges for first metatarsal, two capitates.

Animal:

Cultural:

Data collected: Left talus L = 50 mm, L = 38 mm. A medial extension and slight osteoarthritic lipping is observed in the left talus.

Assignment: A majority of the bones can be assigned to Burial No. 1.

Comments:

Year: 1966

Rectangle: I

Square:

Notes: Misc. material from Burials 1, 2, ?4, ribs.

Bones: Four (adult human) rib fragments.

Animal:

Cultural:

Data collected: None.

Assignment: None.

Comments: Bone fragments were found to be individually wrapped in tissue paper and placed inside a small box, material had not been unwrapped prior to their study in 1987.

Year: 1966

Rectangle: I

Square:

Notes: Miscellaneous material from Burials 1, 2, ?4. Vertebrae, scapula, ulna.

Bones: Approximately 60 small fragments of mostly human bone including skull, long limb bones and ribs.

Animal: Some animal bone and coral fragments.

Cultural: Pieces of coral.

Data collected: None.

Assignment: None.

Comments: Remains found in a small box, too fragmentary for further analysis.

Year: 1985

Rectangle: I

Square:

Notes: Western two thirds to white sand.

Bones: Right talus(adult); fragment of first metatarsal.

Animal: Two pieces of shell.

Cultural:

Data collected: Talus: L = 55 mm, W = 41 mm; medial extension of trochlear surface, neck squatting facet and slight osteoarthritis observed in the talus.

Assignment: None.

Comments: Excavated by Green and Anson in 1985, completion of Specht's Trench 1 excavations.

Year: 1985

Rectangle: I

Square:

Notes: Lower levels (Specht).

Bones: Right patella fragment; left navicular fragment; fragment of right ischium (adult male?); left proximal ulna fragment; left second metacarpal fragment; left fifth metatarsal fragment; proximal hand phalanx; right trapezoid; 5 cranial fragments.

Animal: Some fragments of animal bone.

Cultural:

Data collected: Right patella – measurements: L = 40 mm, W = 42 mm, thickness = 19 mm; non-metric traits: vastus facet present, vastus notch absent, no patellar spurs.

Assignment: All, except ischium and left proximal ulna fragments and right trapezoid, are assigned to Burial 1.

Comments: Excavated by Green and Anson in 1985, completing Specht's work.

Year: 1985

Rectangle: I

Square: E11

Notes:

Bones: None.

Animal: Two major unidentified non-human bone fragments.

Cultural:

Data collected:

Assignment:

Comments:

Year: 1985

Rectangle: I

Square: F10

Notes: Feature Y.

Bones: None.

Animal: Fragment of spinous process of a thoracic vertebra and (?pig) canine.

Cultural:

Data collected: None.

Assignment: None.

Comments:

Year: 1985

Rectangle: I

Square: G11

Notes: Feature 3.

Bones: Distal phalanx of first metatarsal; left metacarpal-4; 3 toe phalanges; metacarpal fragment, cranial fragments.

Animal:

Cultural:

Data collected:

Assignment: Distal phalanx and left fourth metacarpal probably belong to Burial 5.

Comments:

Year: 1985

Rectangle: I

Square: H11

Notes: Burial 2(?)

Bones: Right fibula fragment; left and right tibia fragments; right calcaneus fragment; small fibula and tibia

fragments.

Animal:

Cultural:

Data collected: Left tibia metrics: mid-shaft A-P = 27 mm, trans.= 20 mm, mid-circum = 74 mm; right tibia metrics: mid-shaft A-P = 27 mm, trans.= 21 mm, circum = 77 mm. Squatting facet present in right tibia.

Assignment: Not Burial 2, the two tibia fragments probably go with Burial 1, a small individual (female?).

Comments:

Year: 1985

Rectangle: III

Square: E13

Notes:

Bones: Fragment of left zygoma; middle hand phalanx and many minute bone fragments.

Animal:

Cultural:

Data collected: None.

Assignment:

Comments: Material too fragmentary for further analysis.

Year: 1985

Rectangle: III

Square: F12

Notes:

Bones: Proximal hand phalanx and 3 (human?) bone fragments.

Animal:

Cultural:

Data collected: None.

Assignment: None.

Comments:

Year: 1985

Rectangle: III

Square: F12

Notes: Feature 1.

Bones: Left talus.

Animal: Two pieces of shell/coral.

Cultural:

Data collected: Talus: L = 49 mm, medial extension, neck squatting facet, no arthritic lipping.

Assignment: Talus probably belongs to Burial 3.

Comments:

Year: 1985

Rectangle: III

Square: F13

Notes:

Bones: Five fragments of human bone.

Animal: One fragment of animal bone and one non-human tooth.

Cultural:

Data collected: None.

Assignment: None.

Comments: Material too fragmentary for further analysis.

Year: 1985

Rectangle: III

Square: F13

Notes:

Bones: Distal fragment of large right humerus.

Animal:

Cultural:

Data collected: Size indicates male.

Assignment: Humerus fragment probably belongs to Burial 5.

Comments:

Year: 1985

Rectangle: III

Square: F14

Notes:

Bones: A few fragments which may be human, but majority are non-human.

Animal: Animal tooth and fragments of animal bone.

Cultural:

Data collected: None.

Assignment: None.

Comments:

Year: 1985

Rectangle: III

Square: F and G 12

Notes:

Bones: Unidentified human (?) bone fragments.

Animal: None.

Cultural:

Data collected: None.

Assignment: None.

Comments: Material is too fragmentary to allow further analysis. Some stones identified.

Year: 1985

Rectangle: III

Square: H12

Notes:

Bones: Fragments of scapula, limb bone and upper (right?) central incisor.

Animal: Animal tooth and bone fragments, pieces of coral.

Cultural:

Data collected: Upper right central incisor, measurements: MD = 8.9 mm, BL = 7.5 mm; pathology: calculus = ++, no caries nor hypoplasia. Shovel-shaped condition indeterminate.

Assignment: None.

Comments:

Year: 1985

Rectangle: III

Square: H15

Notes:

Bones: Two small (human?) bone fragments.

Animal:

Cultural:

Data collected: None.

Assignment: None.

Comments: Material too fragmentary for further analysis.

Year: 1985

Rectangle: III

Square: I12

Notes:

Bones: 15 bone fragments.

Animal:

Cultural:

Data collected: None.

Assignment: None.

Comments: Material is too fragmentary for further analysis.

Year: 1985

Rectangle: III

Square: I12/I13

Notes:

Bones: Adult right fifth metatarsal missing distal end; adult left third metatarsal (no head); 6 bone fragments.

Animal:

Cultural:

Data collected:

Assignment: Metatarsal fragments probably from Burial 2.

Comments:

Year: 1985

Rectangle: III

Square: I13

Notes:

Bones: None.
Animal: Most of material is non-human.
Cultural:
Data collected:
Assignment:
Comments:

Year: 1985
Rectangle: III
Square: I13
Notes:
Bones: One small (unidentified) human bone fragment.
Animal: Animal bone.
Cultural: A potsherd.
Data collected: None.
Assignment: None.
Comments:

Year: 1985
Rectangle: III
Square: I15
Notes:
Bones: Approximately 13 human bone fragments.
Animal: Several animal (turtle?) bone fragments.
Cultural:
Data collected: None.
Assignment: None.
Comments: Material too fragmentary for further analysis.

Year: 1985
Rectangle: IV
Square: J10
Notes:
Bones: Human rib and cranial fragments, (first?) molar.
Animal: Large metatarsal and other fragments of animal bone.
Cultural:
Data collected: None.
Assignment: None.
Comments: Material too fragmentary for further identification.

Year: 1985
Rectangle: IV
Square: J10
Notes:
Bones: Fragments of vertebrae; coracoid process (left?); 5 foot phalanges; left third metatarsal fragment; right fifth metacarpal; fragment of left ulna shaft; a single molar.
Animal:
Cultural:
Data collected: Moderate (++) wear on molar.
Assignment: Ulna and left MT-3 assigned to Burial 8; rest of material probably belongs to Burials 7 or 8.
Comments:

Year: 1985
Rectangle: IV
Square: J11
Notes:
Bones: Left talus fragment; right navicular fragment; left third cuneiform; 4 hand phalanges; 2 metacarpal fragments; 7 vertebrae (cervical and lumbar) fragments; rib and various limb bone fragments; 5 fibula fragments; adult premolar tooth.
Animal:
Cultural:
Data collected: Left talus measurements: L = 51 mm, B = 37 mm.
Assignment: Left talus fragment and left cuneiform assigned to Burial 7; right navicular and fibula fragments may go with either Burials 7 or 4.
Comments:

Year: 1985

Rectangle: IV

Square: J11

Notes:

Bones: Right distal humerus fragment; hand (middle) phalanx.

Animal:

Cultural:

Data collected: None.

Assignment: All material from Burial 7 or 8.

Comments:

Year: 1985

Rectangle: IV

Square: J11

Notes:

Bones: Fragments of two phalanges; right lower canine; several unidentified bone fragments.

Animal:

Cultural:

Data collected: Canine tooth: MD = 7.3 mm, BL = 8.2 mm; no caries or hypoplasia; moderate (++) wear.

Assignment: None.

Comments:

Year: 1985

Rectangle: IV

Square: J11

Notes:

Bones: Right third metacarpal fragment, proximal end of left fifth metacarpal; proximal hand phalanx; 4 unidentified human bone fragments.

Animal: Three non-human bone fragments.

Cultural:

Data collected: None.

Assignment: Right third metacarpal and left fifth metacarpal probably belong to Burial 8.

Comments:

Year: 1985

Rectangle: IV

Square: J11

Notes: ?Burial 4

Bones: Right humerus missing head region; cervical vertebrae 1 and 2; many rib fragments, left fifth metatarsal fragment; clavicle fragment; upper right premolar.

Animal:

Cultural:

Data collected: Humerus: mid-circum. = 73 mm, max head diam. = 25 mm, min hd. diam. = 20 mm.

Assignment: Humerus and clavicle belong to Burial 7 or 8; fifth metatarsal assigned to Burial 8.

Comments:

Year: 1985

Rectangle: IV

Square: J12

Notes:

Bones: Small fragment of clavicle.

Animal:

Cultural:

Data collected: None.

Assignment: None.

Comments:

Year: 1985

Rectangle: IV

Square: J12

Notes:

Bones: One possible scapula fragment.

Animal: Most of this material is non-human.

Cultural:

Data collected: None.

Assignment: None.

Comments:

Year: 1985

Rectangle: IV

Square: J12

Notes:

Bones: Large rib fragment, very large (left?) scaphoid fragment; large (left?) second metacarpal; proximal hand phalanx fragment; thoracic vertebra fragment; right second metatarsal; distal end of right ulna.

Animal: Some.

Cultural:

Data collected: None.

Assignment: Scaphoid, second metacarpal and proximal hand phalanx are probably from same individual (either Burial 7 or 8). Ulna fragment may belong to Burial 8 or 4.

Comments:

Year: 1985

Rectangle: IV

Square: J13

Notes:

Bones: Spine of a thoracic vertebra.

Animal:

Cultural:

Data collected: None.

Assignment: None.

Comments:

Year: 1985

Rectangle: IV

Square: J13

Notes:

Bones: None.

Animal: Some.

Cultural:

Data collected:

Assignment: None.

Comments:

Year: 1985

Rectangle: IV

Square: J13

Notes:

Bones: Three vertebrae (cervical) fragments; rib fragment; adult molar (lower right first molar).

Animal:

Cultural:

Data collected: Moderate (++) lipping on centra of lower cervical vertebrae; molar measurements: BL = 11.2 mm, MD = 12.8 mm, dental non-metric traits: slight (+) attrition, no caries, hypoplasia nor enamel extension.

Assignment: None.

Comments:

Year: 1985

Rectangle: IV

Square: J-K10

Notes: Feature marked (e) identified as a human rib fragment.

Bones: Rib fragment.

Animal:

Cultural:

Data collected: None.

Assignment: None.

Comments: Because of the large size and appearance of this fragment, its identification as human is in question.

Year: 1985

Rectangle: IV

Square: K10

Notes:

Bones: Three lower limb fragments.

Animal: Two rib fragments of (?) animal.

Cultural:

Data collected: None.

Assignment: None.

Comments:

Year: 1985

Rectangle: IV

Square: K10

Notes:

Bones: Numerous limb bone fragments, (right?) scapula fragment; large right femur fragment.

Animal:

Cultural:

Data collected: Right femur fragment: sub-trochanteric A-P = 29 mm, Tran. = 25 mm; mid-shaft A-P = 31 mm, Tran. = 24; mid-shaft circum. = 82 mm.

Assignment: Scapula and femur fragment probably are from Burial 8.

Comments:

Year: 1985

Rectangle: IV

Square: K10

Notes: Grey sand midden layer, Spit...June 12, 1985. Fragment of human jaw – “rocker type”, from left side.

Bones: Fragment of left mandible, condyle fragment from left side of same mandible; mandibular left first molar.

Animal: Animal tooth.

Cultural:

Data collected: Measurements and non-metric traits recorded in mandible and teeth as Mandible 1.

Assignment: Mandible 1 not associated with numbered burials from site.

Comments: Adult male (not young).

Year: 1985

Rectangle: IV

Square: K10

Notes:

Bones: Small forearm bone fragment and other small fragments.

Animal: Large number of fragments.

Cultural:

Data collected: None.

Assignment: None.

Comments:

Year: 1985

Rectangle: IV

Square: K10

Notes:

Bones: Thoracic spine fragment; left lunate; scapula and rib fragments; mid-shaft fragment of radius; right first cuneiform; right talus fragment; 2 teeth (upper? left second molar, lower? right second premolar).

Animal: Some non-human bones and coral debris.

Cultural:

Data collected: Left lunate: no arthritis; right first cuneiform: slight osteoarthritis; right talus: slight osteoarthritis.

Assignment: Cuneiform and fragment of right talus probably belong to Burial 4; left lunate may belong to Burials 4, 7 or 8.

Comments:

Year: 1985

Rectangle: IV

Square: K11

Notes:

Bones: Eight small human (limb) bone fragments, a lower (left?) first molar.

Animal: None.

Cultural:

Data collected: Human molar: MD = 11.2 mm, BL = 11.5 mm; moderate (++) wear, no caries.

Assignment: None.

Comments:

Year: 1985

Rectangle: IV

Square: K11

Notes: Black loam layer. Spit 3. Base of deposit. Human skull bones.

Bones: Cranial fragments which were reconstructed to give a relatively complete occipital bone, left zygoma and portion of temporal bone with mastoid process. At least fourteen more cranial fragments and four limb bone fragments were identified.

Animal:

Cultural:

Data collected: Occipital metrics: thickness recorded at lambda (= 12 mm), left asterion(= 10 mm), right asterion (= 11 mm). Cheek height of left zygoma = 26 mm, breadth of mastoid process = 21 mm. There is ridge and slightinion development in the occipital bone.

Assignment: None.

Comments: Material appears to represent one individual, a large male.

Year: 1985

Rectangle: IV

Square: K11

Notes:

Bones: Metatarsals 2, 3, & 5 from right side; distal half of left(?) humerus; distal end of right humerus, fragment (coracoid process) of right scapula.

Animal:

Cultural:

Data collected: None.

Assignment: All, except metatarsals, may belong to Burial 7 or 8. The metatarsals appear to represent a single individual.

Comments:

Year: 1985

Rectangle: IV

Square: K11

Notes:

Bones: None.

Animal: Mostly non-human remains.

Cultural:

Data collected:

Assignment:

Comments:

Year: 1985

Rectangle: IV

Square: K11

Notes:

Bones: Fragment of left patella; proximal fragment of left second metatarsal; metacarpal fragment; several other fragments.

Animal: Some.

Cultural: Pot sherd fragment (red in colour).

Data collected: Left patella Ht. = 18 mm; patellar spurs, vastus facet but no vastus notch, no osteoarthritis; metatarsal fragment exhibits little or no osteoarthritis.

Assignment: Left patella fragment probably belongs to Burial 4; metatarsal fragment may go with either Burials 7 or 8.

Comments:

Year: 1985

Rectangle: IV

Square: K-12

Notes: Grey sand midden layer spit 1:0-10 cm. June 11, 1985. Human jaw and skull fragment associated with big stone high up in pit. Rocker type.

Bones: Left side of mandible with in-tact dentition.

Animal:

Cultural:

Data collected: All material recorded as Mandible 2.

Assignment: Mandible 2.

Comments: Not as large as Mandible 1 but probably male.

Year: 1985

Rectangle: IV

Square: K12

Notes:

Bones: Left fourth metatarsal fragment; large proximal phalanx of first metatarsal; many limb bone fragments.

Animal: Two non-human teeth and non-human bones and bone fragments.

Cultural:

Data collected: None.

Assignment: Foot bones probably from same individual (Burial 8).

Comments:

Year: 1985

Rectangle: IV

Square: K12

Notes:

Bones: Large fragment of right scapula (adult) which preserves a portion of the glenoid cavity, spinous process and adjoining area; upper left adult canine; fragments of rib, vertebrae, metacarpals etc. totalling approximately 38 items.

Animal: Some fragments of animal bone.

Cultural:

Data collected: Glenoid cavity of scapula fragment is free of osteoarthritis.

Canine: Attrition exposes dentin, no caries or hypoplasia observed.

Assignment: Scapula fragment probably goes with Burial 8.

Comments:

Year: 1985

Rectangle: IV

Square: K12

Notes:

Bones: Vertebrae fragments (cervical and thoracic); large right second metacarpal fragment; middle hand phalanx; fragment of maxillary third molar and a complete maxillary right third molar.

Animal:

Cultural:

Data collected: Complete maxillary right third molar; moderate expressions of calculus and attrition, no caries.

Assignment: Large right second metacarpal may belong to Burial 7 or 8.

Comments:

Year: 1985

Rectangle: IV

Square: K13

Notes:

Bones: Several small bone fragments.

Animal:

Cultural:

Data collected: None.

Assignment: None.

Comments:

Year: 1985

Rectangle: IV

Square: K13

Notes: Feature marked (i).

Bones: Two rib fragments and a spinous process of one thoracic vertebra.

Animal:

Cultural:

Data collected: None.

Assignment: None.

Comments:

Year: 1985

Rectangle: IV

Square: Clean-up of all squares.

Notes:

Bones: Fragments of right (adult) patella; middle hand phalanx; more than three limb bone fragments; 16 unidentified bone fragments.

Animal: Some animal bone fragments.

Cultural:

Data collected: Patella measurements: B = 37 mm, W = 19 mm; no vastus notch and no patellar spurring.

Assignment: Patella probably goes with Burial 8.

Comments: