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A Lapita-Associated Skeleton from Waya Island, Fiji

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Abstract—A relatively complete and well preserved skeleton of a 40–50 year old male, associated with Lapita ceramics from Site Y2-25, near Yalobi Village, Waya Island, Fiji, is described. Radiometric dating of the site and of the skeleton indicates the individual lived ca. 2700 years ago (BP). The cranium is short, mesocranic, and high. The face is non-projecting and the orbits and nasal aperture are of medium shape. Caries infection, extreme tooth wear, periodontal disease, premortem tooth loss, and hypercementosis are evident. The upper long limb bones exhibit moderately strong muscle markings while the lower limb bones are more gracile. Living stature is estimated to have been ca 170 cm. A supraclavicular foramen, an oval-shaped fovea capitis, and tibial and talar squatting facets are present. Paleopathological changes observed in the skeleton include cranial osteoporosis, a possible maxillary sinus infection, degenerative osteoarthritis, and slight-to-moderately developed occipital superstructures. Stresses, involving heavy mastication and strenuous physical activity, are at least partly responsible for some of the features observed in this and other Lapita-associated skeletal remains. Limited multivariate comparisons, including the use of FORDISC 2.0 and CRANID2, suggest morphological similarities between the new Fiji cranium and crania from East and Southeast Asia, the presumed homeland of Austronesian-speaking peoples.

Introduction

The initial colonization of Remote Oceania (i.e., the islands east of the main Solomon Islands) began after 3,500 years ago (Irwin 1992). This colonizing episode from the Bismarcks in the west to Fiji-Tonga-Samoa in the east was relatively rapid (300–500 years), and is associated with a distinctively decorated ceramic style known as Lapita (Kirch & Hunt 1988). This cultural horizon is believed to mark the expansion of presumably Austronesian-speaking populations into the central Pacific, including those of Polynesia. Thus, human remains associated with Lapita can inform on the biological affinity of Remote Oceania's first colonists and their descendant populations.

Thus far, human skeletal remains associated with Lapita ceramics, including the new Fijian skeleton described in this paper, have been identified at seven archaeological sites (Figure 1). Few of the previously described Lapita-associated skeletons are complete and most are not well preserved. Only a single partially complete cranium (from New Caledonia) is represented in this assemblage of remains. The extant human skeletal record is discussed later.

The primary objective of the present study is to describe a newly identified skeleton [Burial 1, hereafter referred to as the Y2-25-1 skeleton] associated with

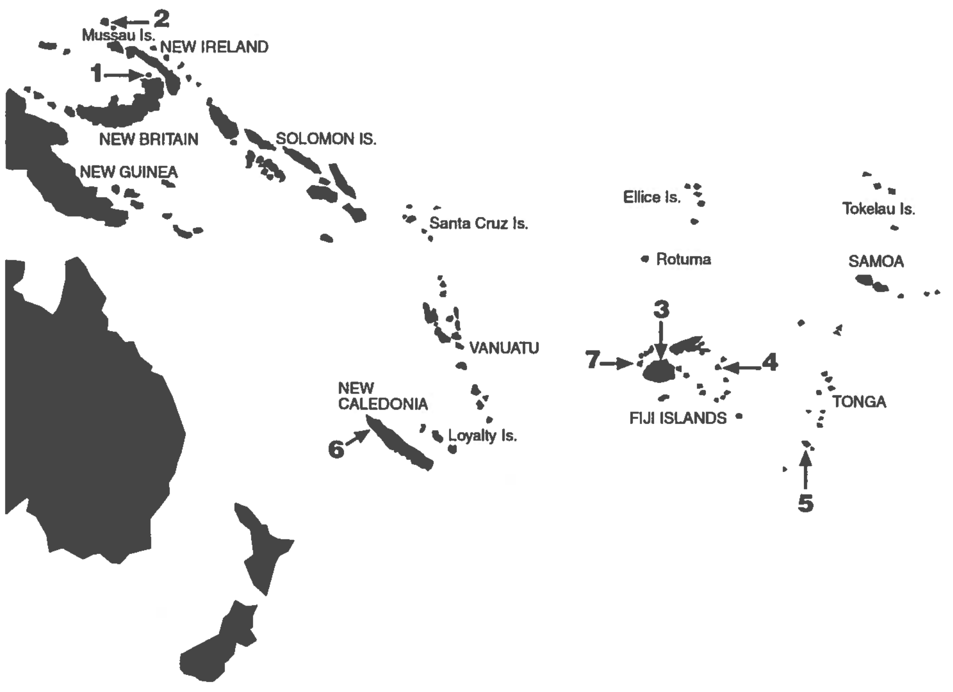

Figure 1. Map of Southwestern Oceania (island Melanesia and West Polynesia) showing the location of sites where Lapita-associated skeletons have been found. [1 = Reber-Rakival, Watom Is., East New Britain; 2 = Mussau Is., New Ireland; 3 = Natunuku, Fiji; 5 = Burial AK, Tongatapu; 6 = WKO-013B, New Caledonia; 7 = Y2-25-1, Waya Is., Fiji].

Lapita ceramics from site Y2-25 at Olo, near Yalobi Village, Waya Island, Fiji Islands. After discussing the archaeological context of the new find, including the radiometric dates of the site and skeleton, we present a detailed osteological description of the new skeleton. Finally, using limited univariate and multivariate comparisons, we assess the biological relationships of the new skeleton from Fiji with other skeletal series associated with Lapita and with non-Lapita ceramic remains for assessing the biological origins of the first inhabitants of Remote Oceania, the ancestors of the present-day Polynesians.

The Y2-25 Site

Site Y2-25 is located on a coastal terrace near the contemporary village of Yalobi on the Island of Waya, Fiji Islands (Figure 2). Preliminary geomorphological reconstructions of the site suggest the formation of the coastal terrace with shoreline progradation during the mid-to-late Holocene (Hunt 1996). Human occupation first occurred on coastal sand dune ridges; as progradation continued, the earliest occupation was covered by colluvial sedimentation of stoney clays derived from adjacent slopes. This process appears to have taken place gradually, incorporating artifactual remains from several centuries of coastal occupation. Similar sequences of shoreline progradation, especially as they relate to cultural deposits, have been documented elsewhere in the region (see e.g., Allen 1997, Hunt & Kirch 1997). Today,

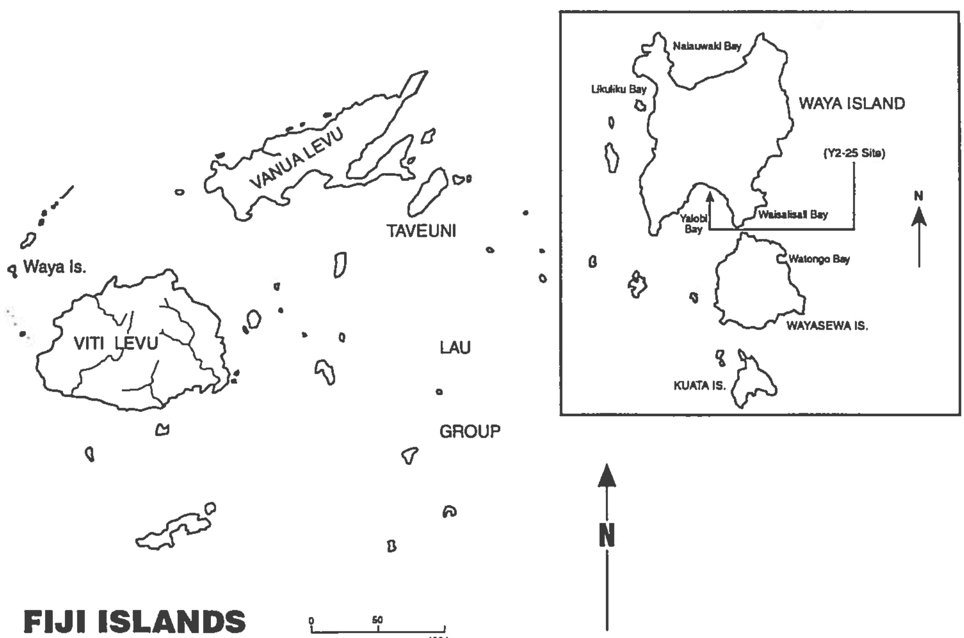

Figure 2. Map of Fiji showing the location of the Y2-25 Site on Waya Island.

the site area is under subsistence cultivation including land held in fallow. The nearby Ratu Naivalu School uses the area for disposal of rubbish in excavated pits.

Archaeological excavations of a $4m^2$ area produced abundant ceramics, a small number of lithic artifacts, and bone and shell midden. The ceramics from the site are largely undecorated and compare to plainwares associated with decorated pottery termed Lapita in the Fiji-Tonga-Samoa region. A very small number of sherds (2) have the distinctive dentate-stamped decoration which defines the Lapita style.

During archaeological excavations at the Y2-25 site, human remains were discovered in the spoils of a rubbish pit excavated by the children from Ratu Naivalu School. The majority of human bone was collected from the spoils and carefully checked for adhering sediment to confirm stratigraphic provenience. Investigation of the exposed profile of the pit revealed more human bone in situ. The stratigraphic context showed the human remains (found in the calcareous sand, Stratum II) were associated with the earliest period of occupation at the site, a conclusion which will be confirmed by our discussion of the radiocarbon dates to follow shortly. Details recorded during excavation (into the side of the rubbish pit where bones remained in situ) suggest that the bones were articulated, in flexed position, and lying on the right side when buried in a shallow pit in the calcareous sand. Abundant pottery sherds and midden were found in direct association with the remains, and probably derive from the deposits excavated for the burial pit.

At present two radiocarbon dates establish an age of approximately 2,700 BP for the human remains and the earliest occupation of the site. A date on charcoal from Stratum II in the adjacent $1m^2$ test pit yielded a date of 2570 $\pm$ 70 BP (Beta-86840). When calibrated (after Stuiver & Becker 1993) the greatest range at one standard deviation is cal 810-539 BC and cal 685-540 BC. To test the age of the human remains directly, a sample of the bone was submitted for accelerator mass spectrometer (AMS) radiocarbon dating of collagen (to University of Colorado, Boulder and Lawrence Livermore National Laboratory's Center for AMS). The radiocarbon age was determined to be 2530 $\pm$ 50 BP (CAMS-24946). The maximum calibrated age range (Stuiver & Becker 1993) at one standard deviation is cal 793-539 BC. The two radiocarbon dates, from bone and charcoal, are statistically identical and provide a reliable measure of the age of the human remains.

The Y2-25-1 Skeleton

The Y2-25-1 skeleton is nearly complete and relatively well preserved (Figure 3). A nearly complete cranium and several bones of the infracranial skeleton of a single individual are represented by the burial. The cranium has been restored from a large number of fragments (Figure 4). The majority of the left cranial vault and the bones from the left facial region are preserved. The facial skeleton is attached to the cranium. Most of the anterior parietal bone and pterion region on the right side are missing, as are the right zygomatic bone and a substantial portion of the right maxillary bone. The posterior hard palate, the central basal region, most of the sphenoid bone, and interior bones of the eye sockets, and nasal aperture, are

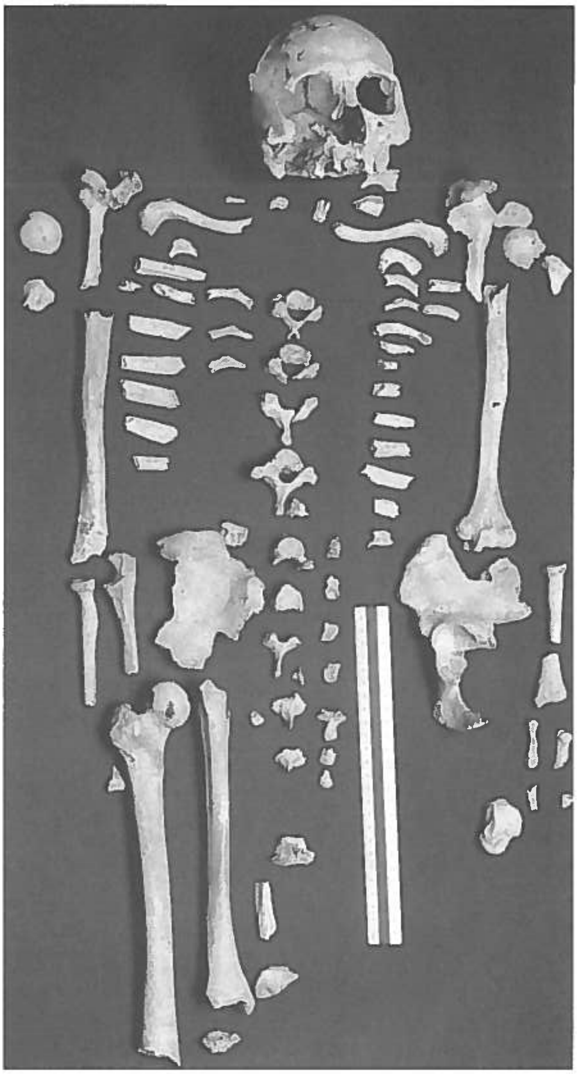

Figure 3. The Y2-25-1 skeleton from Waya Island, Fiji, showing the major elements present and preservation. The remains are those of a 40–50 year old male. The length of the ruler used as a scale in this figure is approximately 12.75 inches in length.

missing. Only four left maxillary teeth remain in their sockets and a left maxillary second molar is also present. The mandible is absent, as are all mandibular teeth. A part of the hyoid body and the left horn were recovered.

With the exception of the left ulna, which is absent, there is partial representation of most of the bones of the upper limb skeleton. The left humerus is the most

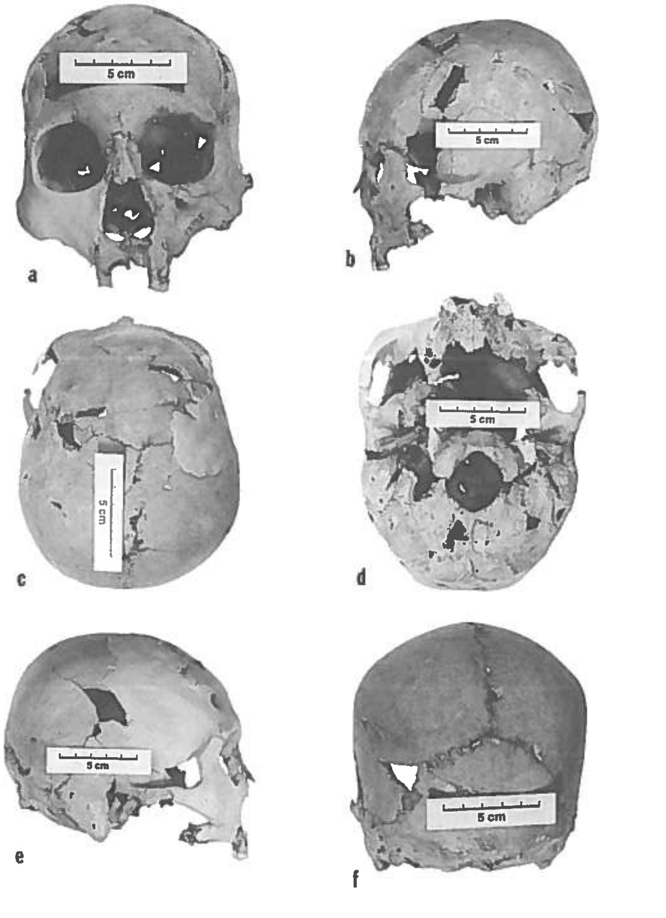

Figure 4. Six views of the Y2-25-1 cranium: a) Frontal view of the cranium of Y2-25-1. There is persistence of the metopic suture in the glabella region, an enlarged infraorbital foramen on the left, notched supraorbital structures, an omega-shaped nasal-frontal junction, and multiple zygo-facial foramina on the left. b) Left lateral view of the reconstructed cranium of Y2-25-1. c) Superior view of the cranium of Y2-25-1. The ectocranial sutures are relatively open. There is postmortem damage in the frontal and right pterion regions. A parietal foramen is visible on the left. d) Inferior view of the cranium of Y2-25-1. The muscle markings in the occipital bone are well developed. The mastoid foramina are enlarged. e) Right lateral view of the cranium of Y2-25-1. An occipital torus is evident in the occiput. The mastoid process and brow ride development are consistent with the male sex. f) Posterior view of the cranium of Y2-25-1. A large parietal foramen is evident on the left. A much smaller foramen is present on the right. There is partial obliteration in the right lambdoidal suture.

complete arm bone; the head is separated from the rest of the shaft and cannot be rejoined. The distal end of the right humerus is missing, and the proximal end is damaged. The proximal third of the right ulna and radius and the proximal and distal ends of the left radius are present. Both clavicles are nearly complete; only the sternal ends are missing. The lateral end of the left clavicle exhibits postmortem damage. The scapulae are represented by the more solid areas adjoining the glenoid fossae and the lateral scapular borders. The left hand is represented by a complete fifth metacarpal, a portion of the first metacarpal and one hand phalanx. None of the bones of the right hand is present. The axial skeleton below the skull is very poorly preserved; representation here includes 15 rib fragments and portions of four cervical, four thoracic, and one lumbar vertebra. Substantial portions of the ossa coxae, however, are present. The lower limb skeleton is represented by a nearly complete right femur and tibia, two fibular shaft fragments, and a left talus. The right femur is missing the distal end, and the right tibia is missing the proximal end. All of the left leg (with the possible exception of a femoral fragment) is missing as are the patellae and the remainder of the feet. The two most nearly complete and intact bones of the infracranial skeleton are the left talus and left fifth metacarpal bone.

Except for extensive postmortem damage, bone preservation in these remains is remarkably good. The bone is solid, moderately heavy, and free of mineral deposits. There is good cortical content. Postmortem weathering is minimal and the external texture of the bone is relatively smooth. The color of the external surface of these bones is light brown/tan.

SEX/AGE

The cranium, although not large, possesses morphological features which are consistent with the male sex. These features include modest brow ridge development, moderately large mastoid prominence, blunt supraorbital margins, a relatively large, rugose zygomatic bone, prominent nuchal cresting, and the absence of infantile features such as frontal bossing.

Morphological features observed in the pelvic region are also consistent with the male sex; these include a narrow sciatic notch, an acute subpubic angle, and the absence of preauricular sulcus, parturition pits, and ventral arc. The auricular surface is consistent with the male sex. The femoral head diameter (46 mm) and linea aspera development further suggest the remains are those of a male.

Because of the presence of relatively intact os coxae, several different methods of aging the pubic symphysis (e.g., McKern & Stewart 1957, Todd 1920, Brooks & Suchey 1990) and auricular surface (Lovejoy et al. 1985) were applied. Additionally, the sternal end of one rib (İşcan et al. 1984) and the ectocranial suture closure methods (Meindl & Lovejoy 1985) were evaluated to estimate the age of this individual. Independent assessment of the results of these various aging methods indicates an age-at-death of approximately 40–50 years. The extensive tooth wear and tooth loss, and the presence of degenerative osteoarthritis, confirm the age-at-death was advanced middle-age. Because such standards are unavailable, the methods used to determine age and sex of the Y2-25-1 skeleton are based on skeletal series from outside the Pacific region.

THE SKULL

The measurements (& indices) recorded in the Y2-25-1 cranium are presented in Table 1. The cranium, although relatively short, is of normal proportions. The vault shape (cranial index) falls in the upper reaches of the medium, or mesocranic, classification, bordering on brachycrany. The cranial vault is high when cranial height is ex-

Table 1. Measurements, indices, and cranial capacity recorded in Burial Y2-25-1, Waya Island, Fiji.

Measurement	in mm	Measurement	in mm
Maximum cranial length (M-1)[1]	173	Bregma-lambda chord (M-30)	110
Naso-occipital length (M-1d)	171	Lambda-opisthion chord (M-31)	97
Basion-nasion (M-5)	97	Bimaxillary subtense (H-SSS)	20*
Basion-bregma (M-17)	139	Nasio-frontal subtense (H-NAS)	13
Maximum cranial breadth (M-8)	138	Nasion-prosthion (H-NPH)	70**
Maximum frontal breadth (M-10)	114*	Frontal subtense (H-FRS)	22
Minimum frontal breadth (M-9)	96	Parietal subtense (H-PAS)	27
Bizygomatic breadth (M-45)	137**	Occipital subtense (H-OCS)	23
Biauricular breadth (M-116)	127	Interorbital breadth II (H-DKB)	17
Minimum cranial breadth (M-14)	80	Rt. frontal emin. thickness (W)	5
Biasterionic breadth (M-12)	106	Lt. frontal emin. thickness (W)	5
Basion-prosthion (M-40)	85**	Midfrontal thickness (W)	6
Nasion-alveolare (M-48)	70**	Bregma thickness (W)	5
Nasal height (M-55)	57	Obelion thickness (W)	7
Nasal breadth (M-45)	27	Rt. parietal emin. thickness (W)	5
Orbital height (M-52)	37	Lt. parietal emin. thickness (W)	5
Orbital breadth (M-51a)	42	Rt. asterion thickness (W)	4
Bijugal breadth [M-45(1)]	116*	Lt. asterion thickness (W)	5
Alveolar length (M-60)	48**	Lambda thickness (W)	6
Alveolar breadth (M-61)	58**	Inion thickness (W)	21
Mastoid height (H-MDL)	29		
Mastoid width (H-MDB)	20	Index	
Bimaxillary breadth (M-46)	103*	Cranial (O)	79.8
Bifrontal breadth (M-43)	106	Height-length (O)	80.3
Biorbital breadth (H-EKB)	93	Height-breadth (O)	100.7
Interorbital breadth (M-49a)	24**	Gnathic (O)	87.6
Malar, inferior length (H-IML)	39**	Upper facial (O)	51.1
Malar, maximum length (H-KML)	57**	Orbital (O)	88.1
Cheek height [M-48(4)]	27	Nasal (O)	47.4
Foramen magnum length (H-FOL)	35	Cranial module (B)	150.0
Nasion-bregma chord (M-29)	109	Cranial capacity (O)	1407.32 cc

[1]M = Martin (1957); H = Howells (1973); W = Webb (1989); O = Olivier (1969); B = Bass (1995).

*These measurements were recorded after restoration of missing areas of the cranium using modelling clay.

**Estimated value.

pressed as a percentage of cranial length (hypsicrane) and cranial breadth (acrocrane). There is no projection of the maxilla (orthognathic) and the upper facial dimensions are medium (mesene). The orbital and nasal aperture are medium. The cranial module is 150. Cranial capacity, calculated using Lee's formula (Olivier 1969:135), is 1407 cc. Measures of cranial thickness indicate the cranial vault is not exceptionally thick.

Non-metric variation observed in the cranium is presented in Table 2. A trace of a metopic suture, measuring approximately 10 mm in length, is present in the

Table 2. Cranial non-metric traits recorded in Burial Y2-25-1, Waya Island Fiji.

Trait	Variation[1]
Metopic suture	persistent on glabella
Frontal grooves	R – absent, L – absent
Supraorbital structure	R – double notch, L – medial & lateral spurred notch
Spina trochlea	R – absent, L – absent
Infraorbital foramen	L – single (enlarged)
Zygo-facial foramen	L – multiple
Infraorbital suture	L – absent
Nasal frontal suture	omega-shaped
Nasal bone shape	hour-glass
Nasal suture deflection	deflection to the left
Subnasal margin	sharp
Marginal tubercle	L – marked
Palatine torus	absent
Os japonicum	L – absent
Maxillary torus	R – absent, L – absent
Anterior condylar canal	R – single, L – single
Precondylar tubercle	absent
Pharyngeal fossa	absent
Ossified apical	absent
Paramastoid process	R – absent, L – absent
Mastoid suture	R – absent, L – absent
Mastoid foramen exsutural	R – temporal bone, L – temporal bone
Parietal foramen	R – single (small), L – single
Coronal wormian	R – absent, L – absent
Bregmatic bone	absent
Sagittal wormian	none
Lambdoidal wormian	R – two?, L – none
Lambdic bone	absent
Vault form	haus-form
Sagittal keeling	absent
Occipital form	mound + ridge + inion
Sagittal-bregma deflection	absent
Parietal notch	R – absent, L – absent
Asterionic bone	R – absent, L – absent
Tympanic thickening	L – absent
Tympanic dehiscence	L – absent
Tympanic marginal foramen	L – absent
Auditory exostoses	L – absent

[1]R = right side, L = left side.

glabella region. Wormian, or extra-sutural, bones are confined to the remnants of two bones in the right lambdoidal suture.

The muscle markings in the occipital region are slightly developed (Figure 5). Recent attention has focused on hyper-development of the occipital region in certain Oceanic groups, including prehistoric Chamorros (Heathcote et al. 1995) and Tongans (Sava 1995). The occipital torus, the site where the trapezius muscle originates, is moderately developed in the present specimen. Following the Heathcote et al. (1996) method of scoring these suprastructures, the present torus is clearly developed (Score = 2) but discrete tubercles are not present. Further present in the same specimen is a slight (Score = 1) retromastoid process, the site where the oblique muscle inserts, on the left side. There is little or no development of this process on the opposite side. A moderately developed (Score = 2) posterior supramastoid tubercle, located on the occipital bone immediately posterior to the asterion, is present on the right, while only a slight swelling (Score = 1) is present on the left side. A slightly developed (Score = 1) anterior supramastoid tubercle is further present on the left side and no corresponding tubercle is present on the right. The occurrence of these structures in the occipital bone has been attributed to physical activity and habitual motion such as lifting and transporting heavy loads.

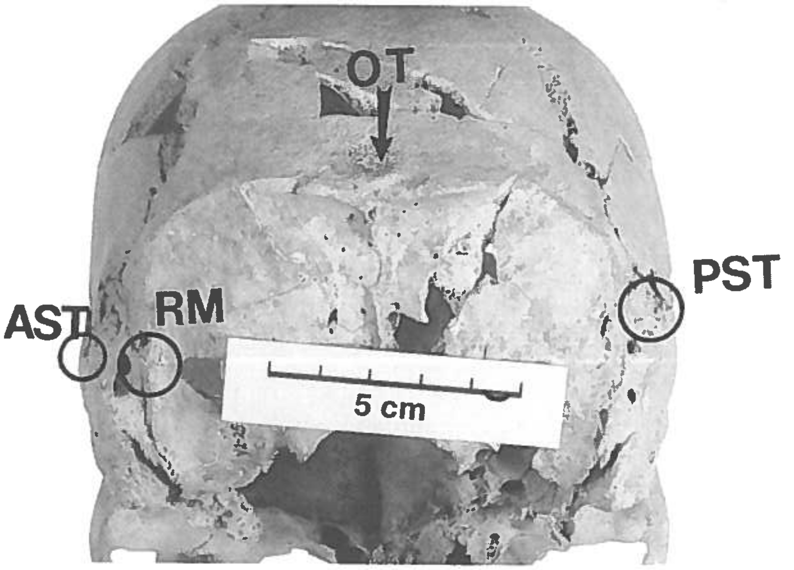

Figure 5. Close-up view of the occipital region of the Y2-25-1 cranium. Note the moderately developed occipital torus (OT) and the enlarged mastoid foramina. A slight retromastoid process (RM) is present on the left. A moderately developed posterior supramastoid tubercle (PST) is present in the right asterion region. A slightly developed anterior supramastoid tubercle (AST) is present on the left.

Cranial Paleopathology

Paleopathological changes observed in the cranium include a small circular area, measuring approximately 12 mm in diameter, superior to the inion process in the occipital bone, which exhibits a coarse-healed porosity. The left infraorbital foramen is unusually enlarged. Postmortem damage has exposed the maxillary sinus cavity on the interior of the left maxilla. A small oval-shaped lesion (measuring approximately 7 mm along the long axis) is visible on the internal surface of the inferior medial margin of the eye socket, medial to the inferior orbital foramen (Figure 6). The indentation has a sharp outline and the interior is somewhat porotic in appearance, suggestive of infection. The infraorbital artery exits at the infraorbital foramen and, among its other functions, supplies blood to the anterior maxillary teeth and to the orbital and cheek regions (Davies with Coupland 1967:796). Given the poor dental health of this individual, and the atypical appearance of the maxillary sinus, the enlarged foramina may be a reaction to infection. The tem-

Figure 6. Interior view of the left maxillary sinus showing an oval-shaped lesion in the medial corner adjacent the inferior medial margin of the left eye socket.

poromandibular joints are free of osteoarthritis. The occipital condyles exhibit slight osteoarthritis. The cranial vault bones, discussed previously, are not unusually thick. The ectocranial sutures exhibit minimal to moderate closure, which is consistent with middle age. There is no osteoporosis (cribra orbitalia) of the superior eye sockets.

Teeth

A total of five maxillary teeth, four in-situ and one loose, were available for study (Figure 7). A record of the teeth present and teeth absent is given in the following diagram:

Right *Left*

(1) 2 ~~3 4 5~~ 6 (7) (8) [9] 10 11 (12) ~~13 14~~ 15 (16)

Numbers without any special feature indicate teeth present
Numbers with strike-out indicate teeth lost premortem
Numbers in brackets [ ] indicate teeth lost postmortem
Numbers in parentheses ( ) indicate teeth and/or region missing

Figure 7. Maxillary dentition of Y2-25-1. The anterior teeth, particularly the right canine, exhibit advanced attrition. Many of the teeth have been lost well before death. The right second molar is much less worn.

Five teeth have been lost premortem, the alveolus is completely healed and resorbed for these teeth. A single tooth, the left central incisor, has been lost postmortem. For the remainder, the alveolus is either missing or damaged thus preventing further observations.

The tooth crown diameters (mesio-distal and buccal-lingual diameters), measured according to Hillson (1986), and cross-sectional areas for four of the teeth are given in Table 3. The teeth are of normal size and no peg-shaped teeth were observed. None of the teeth exhibits enamel extensions or Carabelli's cusps. The cusp pattern in the left second molar is "4-" and in the right second molar it is "4".

Oral-Dental Pathology

Hypercementosis is observed in the maxillary right and left second molars of Y2-25-1 (Figure 8). None of the other molars, including the opposite molars, is present for observation. The roots of the affected molars are noticeably thickened

Table 3. Measurements and cross-sectional areas recorded in the permanent teeth of Burial Y2-25-1, Waya Island, Fiji.

Tooth	Mesio-Distal (mm)	Buccal-Lingual (mm)	Cross-Section Area (mm^2)
Right Maxilla			
Second molar	10.0	12.8	128.0
Canine	7.5	8.6	64.5
Lateral Incisor	6.2	6.7	41.5
Left Maxilla			
Canine	—	—	—
Second Molar	9.9	12.9	127.7

Figure 8. Close-up of the maxillary right and left second molars showing hypercementosis of the roots. The buccal roots of the left second molar have fused. The cementum on the roots of the right molar is not as thick as that on the roots of the left molar.

from the fork of the roots to the apices of each root. The roots of the left second molar are distinctly more enlarged than the right second molar, with fusion of the two buccal roots occurring in the former. Although the alveolar bone surrounding the buccal roots of the right second molar has been lost postmortem, the lingual root does not protrude through the alveolar bone. The left second molar is loose. Although there is premortem tooth loss, extensive tooth wear and bone resorption in the maxillary dentition, the molars with hypercementosis exhibit little wear. The remaining three teeth available for observation, all anterior teeth, are in situ and the roots exposed by postmortem damage do not appear to be thickened.

Hypercementosis, or an excessive build-up of secondary cementum on the root surface of the tooth (Jablonski 1982:398), has several etiologies including accelerated growth, localized injury, malocclusion, chronic malnutrition, periapical inflammation, or systemic disease (e.g., Paget's disease or osteitis deformans) (Anderson 1969:94, Bhaskar 1986:149–150, Spouge 1973:187–188, Wood & Goaz 1980:550–551, Hildebolt & Molnar 1991:226, Corruccini et al. 1987). In the present case, poor dental health and excessive attrition may be responsible.

There is no evidence of calculus build-up in the teeth but postmortem changes to these remains may have erased this evidence. There is evidence of marked alveolar resorption, an indicator of periodontal disease. No enamel hypoplasias, or defects of the enamel, were observed in any of the teeth available for study. Two of the four teeth, both canines, exhibit caries at the enamel-cementum junction (Figure 9). Possible dental abscessing is further present at the site of the right incisor teeth. All teeth exhibit moderate to extreme wear. Most of the crown region of the right canine, especially on the labial surface, exhibits disproportionate wear. The overall dental health of this individual is poor. There is extensive tooth loss, tooth wear, and dental infection. There is no evidence of betel-staining in the surviving teeth.

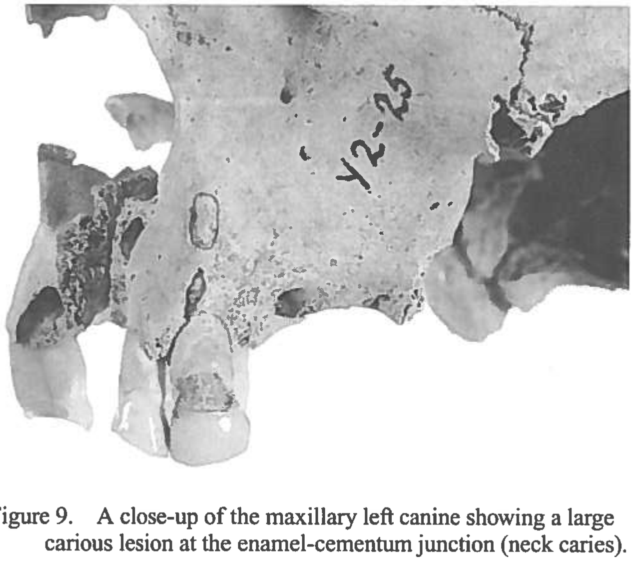

Figure 9. A close-up of the maxillary left canine showing a large carious lesion at the enamel-cementum junction (neck caries).

Infracranial Skeleton

Measurements recorded in the infracranial skeleton are presented in Table 4. Because of the incomplete nature of most of these remains, some of the measurements are estimates; these are indicated in Table 4. The estimated maximum lengths of the right femur and tibia, which are nearly complete,.were determined through comparison with intact bones in the study collections in the laboratory.

Table 4. Infracranial measurements (in mm.) and indices recorded in Burial Y2-25-1, Waya Island, Fiji.

Measurement	Left	Right
Clavicle		
Sagittal diameter, midshaft	10*	11*
Vertical diameter, midshaft	11*	12*
Circumference, midshaft	34*	37*
Humerus		
Epicondylar breadth	61	—
Circumference, midshaft	66*	70*
Maximum diameter, midshaft	21*	23*
Minimum diameter, midshaft	18*	18*
Least circumference	64	65*
Radius		
Head diameter	24	24
Sagittal diameter, midshaft	—	11*
Transverse diameter, midshaft	—	16*
Femur		
Maximum length	—	417*
Maximum head diameter	—	46
Subtrochanteric a-p diameter	—	25
Subtrochanteric trans. diameter	—	33
Midshaft a-p diameter	—	30*
Midshaft transverse diameter	—	26*
Circumference, midshaft	—	87*
Tibia		
Maximum length	—	352*
Maximum epip. breadth, distal	—	50
Maximum diameter, nut. foramen	—	35
Transverse diam., nut. foramen	—	23
Circumference, nut. foramen	—	95
Midshaft a-p diameter	—	32*
Midshaft transverse diameter	—	21*
Circumference, midshaft	—	83*
Talus		
Maximum length	—	55
Maximum breadth	—	47

Index	Left	Right
Humeral diaphyseal	85.7*	78.3*
Crural	—	84.4*
Tibia thickness	—	65.6*
Platymeric	—	75.8
Pilastric	—	115.4*
Platycnemic	—	65.7*

*Estimated measurements.

The humeral diaphyseal index, which measures the degree of flattening of the humeral mid-shaft, indicates the humeral shaft is not flattened (eurybrachia). The deltoid tuberosities are well-developed and the general size of the arm bones indicates a muscular individual. The leg bones are not as robust. Leg length expressed as a proportion of the length of the thigh (crural or tibia-femur index) is estimated at 84.4 for the right side. The upper femoral shaft is flattened (platymeric). The value for this index (75.8) approaches the marked flattening classification. The pilastric index (115.4) indicates the femoral mid-shaft has a medium pilaster. The proximal tibial shaft is not flattened (mesocnemic) in the medio-lateral plane.

Using the estimated maximum lengths of the right tibia and Polynesian stature formulae (Houghton et al. 1975), living height is determined to be 170.4 ± .4 cm. Using the estimated length of the right femur and the Houghton et al. formulae, stature is estimated to be 166.9 ± 1.6 cm.

Non-metric infracranial observations are presented in Table 5. The clavicles exhibit unusual variation in the superior border. A supraclavicular foramen, a nutrient foramen that pierces the superior border, is present in the right clavicle, and

Table 5. Infracranial non-metric traits recorded in Burial Y2-25-1, Waya Island, Fiji.

Bone/Trait	Variation[1]
Clavicle	
Supraclavicular foramen	R – present, L – absent (notch)
Scapula	
Unfused acromial epiphysis	L – absent
Acromion shape	L – rectangular
Humerus	
Supratrochlear spur	L – absent
Septal aperture	L – absent
Ulna	
Trochlear notch	R – hourglass
Os Coxae	
Accessory hip/sacral facets	L – absent
Acetabulum floor morphology	L – notch
Preauricular sulcus	L – groove of ligament
Parturition pits	L – absent
Femur	
Fossa of Allen	R – absent
Third trochanter	R – ridge
Fovea capitis	R – oval
Tibia	
Distal squatting facet	R – present
Talus	
Talar extension	L – medial and lateral extension
Talar squatting facet	L – lateral and central facets

[1]R = right side, L = left side.

an incompletely bridged foramen (notch) is present in the left clavicle (Figure 10). The fovea capitis is oval-shaped in the right femur (Figure 11).

No examples of spina bifida (N = 7), a failure of the spinous process to fuse, were observed. Laminal spurring is present in all the thoracic vertebrae available for study (N = 4).

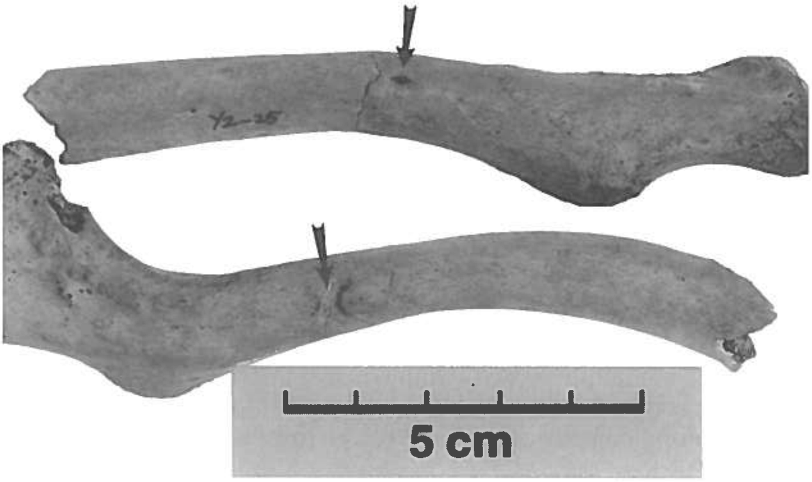

Figure 10. Superior views of the right (top) and left (bottom) clavicles. The right clavicle displays a supraclavicular nutrient foramen and the left clavicle displays an incompletely bridged foramen (notch).

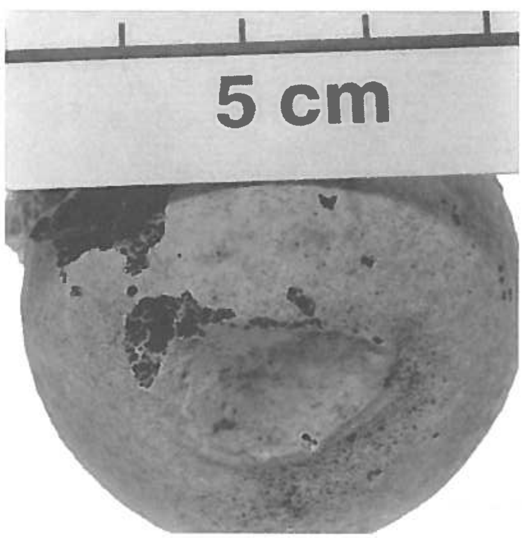

Figure 11. The right femoral head showing an oval-shaped fovea capitis.

There is little or no osteoarthritis in the appendicular skeleton. Slight osteoarthritis was observed in the shoulder (glenoid fossa and proximal humerus), elbow, and hip regions.

A systematic recording of osteoporosis of the vertebral end-plates, osteophytosis of the superior and inferior vertebral centra rims, and osteoarthritis of the articulating facets for each vertebra was made using a grading system representing none (0), slight (+), medium (++), and marked (+++) degrees of involvement (Brothwell 1981:148–150). Parts of at least nine vertebrae are preserved in the Y2-25-1 skeleton. The fifth cervical through fourth thoracic vertebrae are the best-preserved. There is osteophytosis and advanced osteoporosis in the fifth and sixth cervical vertebrae and in the fifth lumbar vertebra.

Although none is complete, the cervical vertebrae represented include the fifth through seventh vertebrae. The small portion of the third cervical vertebra available for observation does not exhibit degenerative changes of the articular facets or centrum. The fourth cervical vertebra is absent. The superior and inferior end-plates of the fifth cervical vertebra are moderately porotic (Figures 12 & 13). In the superior end-plate of this vertebra, the porosis occurs along the posterior vertebral rim with slight osteophytic lipping. The inferior end-plate exhibits more porosis than the superior end-plate; the porosis here is primarily confined to the right centrum and along the anterior vertebral rim. Slight osteophytic lipping is

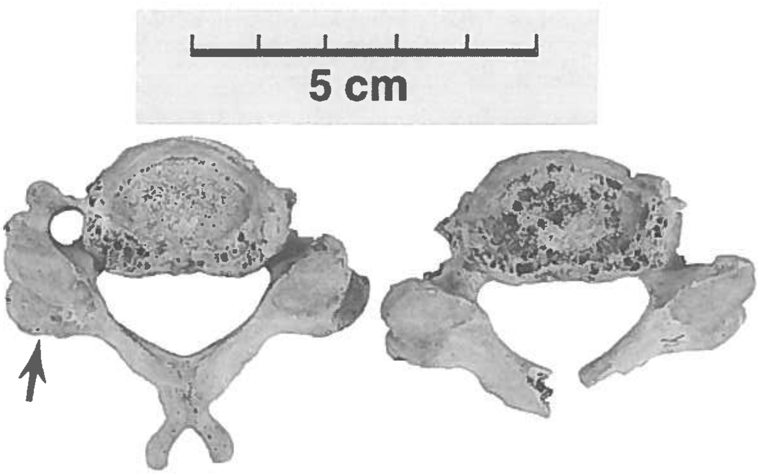

Figure 12. Superior views of the fifth (on left) and sixth (on right) cervical vertebrae depicting moderate porosis of the superior end-plate. Note the bony protrusion (arrow) in the fifth cervical vertebra, which extends posteriorly from the base of the left superior articular facet. A small surface of eburnation occurs between the articular facet and the bony protrusion on the left. The form of the spinous process in the fifth cervical vertebra is divergent and the foramen transversarium on the left side of this vertebra is single.

Figure 13. Inferior views of the fifth (on left) and sixth (on right) cervical vertebrae. The fifth cervical vertebra exhibits moderate porosis of the inferior end-plate. The inferior end-plate of the sixth cervical vertebra is not affected.

further evident in the anterior vertebral rim. A bony exostosis extends inferiorly from the base of the left superior articular facet (Figure 12). A small area of eburnation (or facetting), measuring approximately 3 mm in diameter, occurs between the bony protrusion and where the superior articular facet ends inferiorly. The right superior articular facet and the inferior articular facets are normal, exhibiting only slight arthritic lipping. Possible differential diagnosis includes impaction on the fifth cervical vertebra by the fourth cervical vertebra from above, as a result of degeneration of the disc and loss of disc space. Unfortunately, the fourth cervical vertebra is missing.

The sixth cervical vertebra exhibits moderate porotic changes of the superior end-plate and slight osteophytic lipping. Porosis extends along the posterior vertebral rim and affects most of the superior end-plate. The inferior end-plate of this vertebra is not affected. Arthritic changes of the articular facets of the sixth cervical vertebra are minimal. The centrum and right inferior articular facet of the seventh cervical vertebra are missing. Osteoarthritis of the three remaining articular facets in this vertebra is slight.

The first three thoracic vertebrae (only the first is nearly complete) and a neural arch fragment of the fourth thoracic vertebra are present. The rest of the thoracic vertebrae are missing. In the first thoracic vertebra, osteoporosis and osteophytosis of the end-plates are absent. In the second and third thoracic vertebrae there are no porotic changes visible in the centra, but these two vertebrae exhibit slight osteophytosis of the superior and inferior end-plates. There are no arthritic changes in any of the articular surfaces of the thoracic vertebrae.

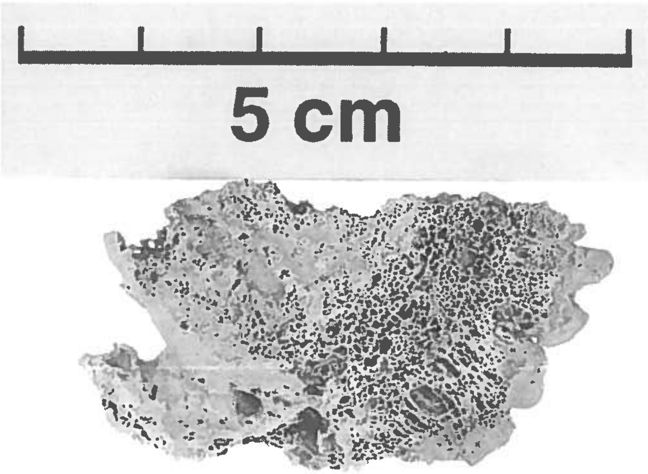

Figure 14. A fragment of the fifth lumbar vertebral centrum. Marked osteophytic lipping is evident on the superior anterior end-plate of this vertebra.

The only representation of the lumbar spine is a small fragment of the fifth lumbar vertebra which includes part of the centrum and a fragment of the spinous process. The superior anterior end-plate exhibits marked osteophytic lipping (Figure 14). While much of the superior end-plate appears solid and unaffected by osteoporosis, there is possible porosis of the end-plate adjacent to the anterior vertebral rim. Postmortem weathering prevents further observation. Most of the inferior end-plate is missing.

Overall, observations of degenerative changes in the spinal column of Y2-25-1 include slight to marked osteophytosis of the vertebral bodies (6/11 or 54.5%), slight osteophytosis of the articular facets (5/22 or 22.7%), and slight to marked osteoporosis (4/6 or 66.7%).

Comparisons

In an attempt to place the Y2-25-1 skeleton within a broader interpretive context, limited comparisons are made with the few previously described Lapita-associated skeletons and some non-Lapita-associated skeletal series.

With the addition of the present skeleton, there are now several documented archaeological sites (located in Fiji, Tonga, Bismarck Archipelago, and New Caledonia) with Lapita Cultural Complex skeletal remains (see Table 6 & Figure 1). With the exception of the Watom material, the number of burials represented at each site rarely exceeds one. Not including the scattered and fragmentary remains from Mussau, approximately 15 individuals are represented in these samples. None of the skeletons is complete, and preservation of the bones is generally poor. The most nearly complete (restored) crania are the Y2-25-1 (Fiji) and WKO-013B

Table 6. Lapita-associated skeletons from Near and Remote Oceania.

Site/Location	Description of Remains	Dating of Remains	References
(Near Oceania)			
1. Reber-Rakival, Watom, East New Britain	Eight adult (6 male, 2 female) skeletons of varying completeness, no complete crania. Age range of these individuals is 18–40 years. MNI = 8.	ca500 B.C.—100 B.C.	Specht (1968); Green & Anson (1987); Houghton (1989a); Pietrusewsky (1989a).
2. Mussau or St. Mathias Group, New Ireland	Fragmentary and incomplete skeletal and dental remains from four sites on Eloaua, Emananus and Mussau Islands. MNI = unknown.	ca1600 B.C.—500 B.C. (occupation dates of sites)	Kirch et al. (1989).
(Remote Oceania)			
3. Y2-25-1, Waya, Is., Fiji	Cranium and partial infracranial skeleton of a middle-aged male. MNI = 1.		This study.
4. Natunuku (VL1/1), Viti Levu, Fiji Is.	A partially complete skeleton of an adult male, approx. 50 years old. MNI = 1.	0–500 B.C.	Shaw (1975); Pietrusewsky (1985, 1989b); Davidson et al. (1990).
5. Lakeba, Lau Group, Fiji Is.	Incomplete remains of at least two individuals. The primary burial is a 30–40 year old male. MNI = 2.	Middle of early part of first millennium B.C. (ca 500 B.C.)	Best (1977); Houghton (1989b).
6. Burial AK, Tongatapu, Tonga Is.	A partially complete skeleton and portions of a second individual. The primary burial is a middle-aged male. MNI = 2.	Late Eastern Lapita Age	Poulsen (1987); Spennemann (1987); Houghton (1989c).
7. WKO-013B, Koné, New Caledonia	A substantially complete skeleton of a 35–45 year old female, including a partially restored cranium. MNI = 1.	Second half of the first-millennium B.C.	Dédane & Kasarhérou (1988); Pietrusewsky et al. (n.d.).

(New Caledonia) specimens. Almost without exception, the Lapita-associated skeletal remains date to the latter half of the temporal phase, 0-500 B.C. Although these remains are relatively incomplete, poorly preserved, geographically isolated, limited in number, and relatively late in time, they represent the only direct means of assessing the probable biological origins of the Polynesians.

Cranial Metric Comparisons

Two fragmentary and incomplete male crania from Watom Island, and one from Tonga, and an incomplete adult female cranium from Koné, New Caledonia, allow limited comparisons with Y2-25-1. Craniometric data recorded in four specimens (Table 7) indicate similarities as well as differences. The minimum frontal breadth measurements in the Y2-25-1 and Watom 3 frontal bones are similar as are the nasal breadth, cheek height, nasion-bregma chord, and nasio-frontal subtense measurements. Cheek height in these four specimens ranges from 23–27 mm. Cheek height in Y2-25-1 is identical to the Burial AK from Tonga. Cranial thickness (not shown) recorded at the inion is 21 mm in the occipital bones of Y2-25-1 and Natunuku.

Multivariate Craniometric Comparisons

Two computer programs were used in an attempt to classify Y2-25-1 with known skeletal series. The first, FORDISC 2.0 (Ousley & Jantz 1996), uses a discriminant function analysis to classify crania of unknown origin to one of eleven modern forensic reference samples using up to 21 cranial measurements. Using 17 cranial measurements, the Y2-25-1 cranium is classified as a Chinese (Hong Kong) male. Both the posterior probability score (.561) and typicality probability score (.245) are low, however, suggesting Y2-25-1 is not typical of this group. Unfortunately, none of the reference samples utilized is from the Pacific region, making this

Table 7. Cranial measurements of individual male Lapita specimens.

Measurement[1]/Series[2]	Y2-25-1	Watom 3	Watom 6	Burial AK
Minimum frontal breadth (M-9)	96	94	—	—
Nasal breadth (M-45)	27	26	—	26*
Alveolar length (M-60)	48*	59	61	—
Mastoid height (H-MDL)	29	—	31	—
Mastoid width (H-MDB)	20	—	19	—
Biorbital breadth (H-EKB)	93	103	—	—
Interorbital breadth (M-49a)	24*	31	—	—
Malar length, inferior (H-IML)	39*	26	44	—
Malar length, maximum (H-KML)	57*	39	55	—
Cheek height [M-48(4)]	27	25	23	27
Nasion-bregma chord (M-29)	109	106	—	—
Bregma-lambda chord (M-30)	110	92	—	—
Nasio-frontal subtense (H-NAS)	13	14	—	—

[1]M = Martin (1957); H = Howells (1973).
[2]See Table 6 for references.
*Estimated value.

a reasonable classification result. A further feature of this program is that it compares the unknown specimen to 25 populations used by Howells (1973, 1989). Using 21 cranial measurements, Y2-25-1 is classified as a Guamanian male. The posterior and typicality probability scores, however, suggest this assignment is not typical of this group. A two dimensional canonical plot, representing 46.3% of the total variation, places Y2-25-1 closest to two Polynesian series (Moriori and Mokapu) and Guam. The only cranial sample from Melanesia (Tolai of New Britain) used in this comparison, demonstrates no connection with Y2-25-1.

A second computer software package, CRANID2 (Wright 1992a, 1992b), which uses a principal components analysis and cluster analysis and a much wider range of crania from around the world, indicates the crania nearest to Y2-25-1 are from Hainan Island (southern Chinese), Aboriginal Taiwan (Atayal), Guam, and the Philippines. This computer program removes the principal component of size, allowing comparison of cranial shapes regardless of sex. Using 20 components, analysis of the Y2-25-1 cranium indicates that it is nearest to crania from Hainan Island (12), Atayal (8), Guam (5), and the Philippines (5). Approximately sixty percent of the 50 nearest neighbors are from southern China, Taiwan Aborigines, the Philippines and Guam, suggesting an east Asian/southeast Asian connection.

Cranial Non-Metric Comparisons

Comparisons of the non-metric cranial variation in Y2-25-1 and some more nearly complete Lapita-associated skeletons/series (Table 8) demonstrate a relative homogeneity in these series. There is a universal absence of complete metopic suture, frontal grooves, spina trochlea, palatine and maxillary tori, parietal notching, tympanic thickening, dehiscence and marginal foramina, and auditory exostoses in these specimens. A supraorbital notch formation and a single parietal foramen are present in all the Lapita-associated crania available for study. Zygo-facial foramina are absent in Y2-25-1 and Burial AK and present in WKO-013B. The subnasal region is sharp in Y2-25-1 but not in the other specimens. Marginal tubercles are present in Y2-25-1 and WKO-013B.

The presence of occipital suprastructures, especially occipital torus and retromastoid processes, observed in Y2-25-1, has a particularly high prevalence among the indigenous inhabitants of the Mariana Islands (Chamorro) and in Tonga (Heathcote et al. 1995, Sava 1995).

Dental Comparisons

Tooth crown dimensions of three maxillary teeth present in Y2-25-1 are compared with other Lapita-associated dental series (Table 9). There are few tooth size differences evident in these samples. The Y2-25-1 maxillary second molars are slightly larger than any of the other Lapita-associated series. The cross-sectional area of this tooth is very similar to the other Lapita-associated skeletons and populations found within the geographical boundaries of Melanesia (Brace & Hinton 1981). The relatively smaller cross-sectional areas for WKO-013B can be attrib-

Table 8. Cranial non-metric variation in Lapita skeletons (right and left sides combined).

Trait/Series[1]		Y2-25-1	Watom	WKO-013B	Burial AK, Tonga
Metopic	n/N	0/1	0/1	0/1	—
suture	%	0.0	0.0	0.0	
Frontal	n/N	0/2	0/2	0/2	—
grooves	%	0.0	0.0	0.0	
Supraorb. notch	n/N	2/2	1/1	1/1	—
	%	100.0	100.0	100.0	
Spina	n/N	0/2	0/2	—	—
trochlea	%	0.0	0.0		
Zygo-facial for.	n/N	0/1	3/3	1/2	0/1
single	%	0.0	100.0	50.0	0.0
Nasal-frontal sut.	n/N	1/1	1/1	—	—
omega	%	100.0	100.0		
Subnasal	n/N	1/1	0/1	0/1	0/1
sharp	%	100.0	0.0	0.0	0.0
Marginal tubercle	n/N	1/1	0/1	2/2	—
	%	100.0	0.0	100.0	
Palatine torus	n/N	0/1	0/1	—	—
	%	0.0	0.0		
Maxillary torus	n/N	0/2	0/2	0/2	0/2
	%	0.0	0.0	0.0	0.0
Parietal foramen	n/N	2/2	1/1	2/2	—
single	%	100.0	100.0	100.0	
Parietal notch	n/N	0/2	0/1	0/2	—
	%	0.0	0.0	0.0	
Tympanic	n/N	0/1	0/1	—	—
thickening	%	0.0	0.0		
Tympanic	n/N	0/1	0/1	—	—
dehiscence	%	0.0	0.0		
Tympanic	n/N	0/1	0/1	—	—
marginal foramen	%	0.0	0.0		
Auditory exostoses	n/N	0/1	0/1	0/2	—
	%	0.0	0.0	0.0	

[1]See Table 6 for references.

uted to the female sex of this skeleton. There is very little difference in size when the canine and lateral incisor dimensions of Y2-25-1 are compared to the remaining dental series. The majority of the samples, including Y2-25-1, approximate the large dental dimensions recorded in the other Lapita-associated teeth and in Melanesian series.

Dental non-metric variation recorded in the Y2-25-1 teeth and in several of the Lapita-associated series is given in Table 10. There is a consistent absence, or low frequency of occurrence, of peg-shaped teeth, enamel extensions, and Carabelli's cusps.

Some of the Lapita-associated skeletons, including Y2-25-1, are exceptional for the poor dental health they exhibit (Table 11). The frequencies of carious teeth,

Table 9. A comparison of some mean maxillary tooth dimensions in Lapita dental series (right and left sides combined).

Tooth Dimension[1]	Y2-25-1[2]	Lakeba[3]	Mussau[4]	Watom[5]	Natunuku[6]	WKO-013[7]
M2						
MD	10.0	10.5	10.4	10.2	10.1	7.9
BL	12.9	11.7	11.5	11.7	12.3	11.0
CX	129.0	122.9	119.6	120.5	124.5	86.9
C						
MD	7.5	8.5	8.1	7.5	—	6.9
BL	8.6	9.1	8.4	8.5	—	8.2
CX	64.5	77.4	68.0	63.8	—	56.6
I2						
MD	6.2	6.5	7.7	6.7	—	5.1
BL	6.7	6.9	8.1	6.6	—	6.8
CX	41.5	44.9	62.4	44.7	—	32.2

[1]MD = mean Mesial-Distal diameter in mm; BL = mean Buccal-Lingual diameter in mm; CX = mean Cross-Sectional area (mean MD × mean BL) in mm^2; N = Number of teeth measured in the sample.
[2]Present study.
[3]Houghton (1989b).
[4]Kirch et al. (1989).
[5]Pietrusewsky (1989a).
[6]Pietrusewsky (1989b).
[7]Pietrusewsky et al. (n.d.).

Table 10. Dental non-metric variation in Lapita series.

Trait/Series[1]	Y2-25-1	Natunuku	Burial AK Tonga	Watom	WKO-013B	Mussau
Peg-shaped Teeth	0/5	0/5	0/9	0/53	0/28	none
	0.0	0.0	0.0	0.0	0.0	reported
Enamel Extensions	0/2	0/1	1/5	0/31	0/17	1 enamel
(molar + premolar)	0.0	0.0	20.0	0.0	0.0	pearl
Carabelli's Cusp	0/2	0/1	—	0/10	0/3	0/3
	0.0	0.0		0.0	0.0	0.0

[1]See Table 6 for references.

dental abscessing, marked attrition, and premortem tooth loss are among the highest in the Y2-25-1 teeth. The Natunuku specimen from Fiji, and Burial AK from Tonga, also exhibit extensive caries, attrition, and premortem tooth loss. In contrast, the Watom and WKO-013B teeth have far fewer dental pathologies than the other Lapita-associated series. Kirch et al. (1989) have reported occlusal caries in two molars, evidence of moderate periodontal disease, and dental attrition involving the secondary dentine, in the Lapita-associated dental remains from the Mussau Islands.

Table 11. Dental pathology in Lapita series.

Pathology/Series[1]	Y2-25-1	Natunuku	Burial AK Tonga	Watom	WKO-013B
Enamel Hypoplasia[2]	0/4	0/5	0/9	2/52	3/25
	0.0	0.0	0.0	3.8	12.0
Caries	2/5	3/5	12/14	0/52	1/28
	40.0	60.0	85.7	0.0	3.6
Abscessing	2/6	—	2/16	0/42	1/28
	33.3		12.5	0.0	3.6
Attrition[3]	3/5	4/5	16/16	21/52	8/25
	60.0	80.0	100.0	40.4	32.0
Premortem Tooth	5/11	extensive	1/12	1/26	0/25
Loss[4]	45.5		8.3	3.8	0.0

[1]See Table 6 for references.
[2]Any expression of hypoplastic defects in incisors and canines.
[3]Includes wear scored as reaching the dentin (moderate), pulp and root only.
[4]Premortem loss scored in the maxillary teeth.

The severe dental attrition seen in Y2-25-1 mirrors that observed in the Sigatoka skeletal series from Fiji, where chewing and/or preparation of kava and diet have been invoked to explain the elevated frequency of tooth wear and degeneration in the temporomandibular joint (Visser 1994).

Hypercementosis

Examples of hypercementosis, or thickened cementum covering the root region, in other Pacific skeletal series appear to be rare. The condition is probably greatly under-reported since the roots are seldom exposed. A single individual from the Sigatoka burial mound site, a 45–50 year old female, has hypercementosis in all of the maxillary molars (Pietrusewsky et al. 1994). The dental health of this individual is poor and includes extensive root resorption, premortem tooth loss, caries, and abscessing. This individual also has marked osteophytosis and porosis of the cervical vertebrae.

Infracranial Metric Comparisons

Some comparisons (Table 12) of infracranial indices for Lapita-associated skeletons indicate that the humeral shafts of the Y2-25-1, Watom, and Burial AK skeletons do not exhibit flattening or platybrachia. The crural index, which expresses the relative lengths of the tibia and femur, is available for only the Y2-25-1 and Natunuku skeletons on the right side. The two values for this index are very similar.

Almost all of the Lapita-associated femora, including Y2-25-1, exhibit upper shaft flattening, or platymeria. The pilastric index, which expresses the form of the femoral mid-shaft, indicates either medium or strong pilastric development for the series compared. With the exception of one anomalous index for Watom, the tibia thickness index is of uniform expression in the Lapita-associated skeletons, these values falling within a relatively narrow range. Finally, the platycnemic index, which expresses the degree of flatness of the medio-lateral plane of the proximal tibial shaft is generally mesocnemic for the majority of the Lapita-associated skeletons.

Estimated statures of the Lapita-associated skeletons (Table 13) indicate a relatively narrow range (170 cm–174 cm). Similar stature estimates have been reported for skeletal remains (not associated with Lapita ceramics) from Fiji (Prochownich 1887, Pietrusewsky et al. 1994) and Polynesia (Pietrusewsky 1969).

Table 12. Infracranial indices in male Lapita skeletons.

Index/Series[1]		Y2-25-1	Watom	Burial AK	Natunuku
Humeral diaphyseal	L	85.7*	81.3	95.2	—
	R	78.3*	82.6	90.5	—
Crural (tibia-femur)	L	—	—	—	—
	R	84.4*	—	—	88.7
Platymeric	L	—	84.8	78.1	81.2
	R	75.8	88.9	—	81.2
Pilastric	L	—	119.3	123.1	124.0
	R	115.4*	118.8	—	128.0
Tibia thickness	L	—	65.5	64.5	64.5
	R	65.6*	84.6	—	66.7
Platycnemic	L	—	72.3	61.1	67.6
	R	65.7*	67.2	—	63.9

[1]See Table 6 for references.
*Value calculated from estimated measurements.

Table 13. Estimates of stature in Lapita skeletons.[1]

Site (Specimen)[2]	Cm	Ft. in.	Bone or Segment Length (cm)
Males			
Y2-25-1	170.4	5′7″	R. Tibia estimated length (35.2)
Watom 3	176.2	5′9″	R. Femur Seg. 4 (3.9)
Watom 4	170.0	5′7″	R. Femur Seg. 2 (23.5)
Watom 5	173.7	5′8″	L. Humerus (32.5)
Watom 6	180.0	5′11″	L. Humerus (35.0)
Watom 7	172.7	5′8″	R. Femur Seg. 2 (24.8)
Watom 8	171.9	5′7″	L. Tibia Seg. 3 (13.6)
Natunuku, Fiji	172.7	5′8″	R. Femur (44.4)
Burial AK, Tonga	171.1	5′7½″	L. Radius (24.4)
Lakeba, Fiji	171.1	5′7½″	R. Radius (24.5)
Mussau, New Ireland	170.5	5′7″	R. Humerus (31.0)
Females			
Watom 1	164.0	5′5″	R. Femur Seg. 1 (7.7)
Watom 2	154.7	5′1″	L. Femur Seg. 2 (21.1)
WKO-013B	161.7	5′3½″	L. Tibia (33.5), Fibula (32.6), and Radius (22.4) estimated lengths

[1]Stature estimates were made using Houghton et al. (1975) formulae.
[2]See Table 6 for references.

Infracranial Non-Metric Comparisons

A few non-metric infracranial traits recorded in the Lapita-associated skeletons are reported in Table 14. A supraclavicular foramen is observed in the Y2-25-1 and Watom clavicles. Septal aperture is rare in the Lapita-associated skeletons although only seven sides (all but one are male) are available for study. The fovea capitis, for insertion of the ligamentum teres, is generally oval-shaped in Lapita-associated femora. Tibial and talar squatting facets are equally common in all specimens. The superior border of the gluteal crest, where the gluteus maximus originates, is roughened in the Lapita-associated femora.

A relatively high frequency of supraclavicular foramina has been reported in the Sigatoka skeletal series from Fiji (Pietrusewsky et al. 1994). Ridged gluteal crests and oval fovea capiti, two traits observed in Y2-25-1, are common in the skeletal series from Fiji and Tonga (Pietrusewsky et al. 1994).

Paleopathology Comparisons

Limited comparisons of advanced degenerative changes in the cervical vertebrae, found in Y2-25-1, can be made (Table 15). Houghton (1989b) found little or no degeneration in the pre-sacral vertebral column of the primary skeleton, a 30–40 year old male, from Lakeba, Fiji. For the Watom skeletal series from New Britain, very few degenerative changes were observed in the vertebral columns of the six adult individuals in this sample (Pietrusewsky 1989a). Likewise, there was little or no osteoarthritic degeneration in the vertebral column of the 35–45 year old female skeleton from Koné, New Caledonia (Pietrusewsky et al. n.d.). However, moderate osteoarthritis was observed in the Burial AK from Tonga (Spennemann 1987:300), an observation confirmed by M.P., who examined these remains in 1987. The vertebrae most severely affected include the second cervical through the sixth cervical vertebrae, whose centra exhibit moderate osteophytosis and lipping. The articular facets available for observation possess slight to moderate degenerative changes.

Table 14. Infracranial non-metric variation in Lapita series (sides and sexes combined).

Trait/Series[1]		Y2-25-1	Burial AK	Watom	WKO-013B
Supraclavicular	n/N	1/2	—	2/7	0/1
foramen	%	50.0		28.6	0.0
Septal aperture	n/N	0/1	0/2	1/3	0/1
	%	0.0	0.0	33.3	0.0
Third trochanter	n/N	1/1	1/1	3/3	1/1
ridge	%	100.0	100.0	100.0	100.0
Oval fovea capitis	n/N	1/1	—	3/5	2/2
	%	100.0		60.0	100.0
Tibial squatting	n/N	1/1	1/1	2/2	1/1
facet	%	100.0	100.0	100.0	100.0
Talar squatting	n/N	1/1	1/1	12/13	—
facet	%	100.0	100.0	92.3	

[1]See Table 6 for references.

Table 15. Frequency of occurrence of advanced[1] osteoarthritis, osteophytosis, and osteoporosis in the cervical vertebrae of Lapita skeletal series.

Skeletal Series	Osteoarthritis of Articular Facets		Osteophytosis of Centra		Osteoporosis of Centra	
	n/N	%	n/N	%	n/N	%
Y2-25-1, Fiji[2]	0/11	0.0	0/4	0.0	2/2	100.0
Watom, New Britain[3]	0/48	0.0	0/26	0.0	0/15	0.0
Burial AK, Tonga[3]	2/12	16.7	7/12	58.3	0/2	0.0

[1]Moderate (++) and marked (+++) levels of degenerative change.
[2]Present study.
[3]Data recorded by Pietrusewsky in 1987 at the Department of Anatomy, University of Otago, Dunedin, New Zealand.

Other skeletal series which have elevated frequencies of occurrence of advanced vertebral osteoarthritis include the skeletons from two prehistoric burial mounds on Tongatapu, Tonga Islands (Pietrusewsky 1969). It was reported that the males in this series were more likely to exhibit osteoarthritic changes in the neck region than in the lower back (lumbar vertebrae). In females, from the same skeletal series, the pattern is reversed with more degeneration occurring in the lumbar regions than in the cervical vertebrae (Pietrusewsky ibid). Spennemann (1987: 300) attributes these observed differences in the Tongan material to occupational differences and suggests that men were involved in water transport (canoeing) and fishing while females were more involved in land transport, in particular the transport of garden products to the household. The Y2-25-1 skeleton, a male, approximates the pattern observed in the male Tongans.

Summary and Conclusions

The relatively well-preserved skeletal remains of a 40–50 year old male (Y2-25-1) from Waya Island, Fiji, who lived approximately 2700 years ago, increases the number of Lapita-associated skeletons from the Pacific to approximately 15 individuals. The Y2-25-1 cranium is nearly complete but lacks the mandible.

The cranium, although unusually short, possesses a medium cranial index, high vault, orthognathic face, and medium nasal and orbital dimensions. The lack of complete male crania precludes a detailed comparison and an assessment of biological relationships with other Lapita-associated crania. Limited multivariate comparisons indicate affinities between the Y2-25-1 cranium and cranial series from Hainan Island, Taiwan (Atayal), Guam, and the Philippines, which suggests an ancestral homeland in Southeast Asia and off the southern coast of China. Among the non-metric cranial features observed in Y2-25-1 are a persistence of the metopic suture on the glabella, absence of an infraorbital suture, an enlarged infraorbital foramen, a sharp subnasal border, a multiple zygo-facial foramen, a marginal tubercle, notched supraorbital structures, several small lambdoidal wormian bones, and anterior condylar canals that are single. Comparison of cranial non-metric traits in Lapita-associated cranial series fails to differentiate these series. Muscle markings in the occipital bone are slightly to moderately developed in Y2-25-1 and suggest vigorous physical activity resulting in hypertrophy of the neck and shoulder musculature. Such structures have been observed to be well developed in late prehistoric skulls from the Mariana Islands in western Micronesia and in Tongan crania in western Polynesia. The occipital condyles in the Y2-25-1 cranium exhibit slight degenerative osteoarthritis.

The tooth crown dimensions of the Y2-25-1 teeth are similar to other Lapita-associated dental series and to larger-toothed Melanesians. Dental non-metric traits observed in the Y2-25-1 teeth include the absence of Carabelli's cusps and enamel extensions.

The dental health of the Y2-25-1 individual is generally poor. There is evidence of dental caries, extreme tooth wear, periodontal disease, and premortem tooth loss. Several of the other Lapita-associated skeletons have similar poor dental health. A condition not frequently observed in Pacific dentitions, hypercementosis, or thickening of the secondary cementum, is observed in two molar teeth. Hypercementosis has been observed in a female skeleton from the Sigatoka burial dune on the island of Viti Levu, Fiji, a series also characterized by poor dental health and extreme attrition.

The estimated stature of the Y2-25-1 skeleton is approximately 170 cm. The stature of Y2-25-1 is similar to but smaller than most other estimated statures of male Lapita-associated skeletons and those of Pacific Island skeletal series. The arm bones of Y2-25-1 are robust and have strong muscle markings, while the leg bones are less rugose. A supraclavicular foramen, oval-shaped fovea capitis, and talar squatting facets are observed in the infracranial skeleton. Morphological features of the infracranial skeleton, including limb bone dimensions and proportions, further fail to differentiate any of the Lapita-associated skeletal series. The Y2-25-1 individual suffered from degenerative osteoarthritic changes in the neck and lumbar regions, a pathological condition observed in several of the Lapita-associated and Pacific Island skeletal series.

Aspects of dental pathology, morphological changes to the cranium and upper limb, and degenerative changes in the vertebral column, observed in Y2-25-1 suggest regional adaptations involving heavy mastication and strenuous physical activity involving the upper torso and neck region. This morphological picture finds parallels in several other Lapita-associated coastal skeletal series from Tonga, Fiji, and the Mussau Islands of New Ireland, and prehistoric remains from the Sigatoka dune burial complex in Fiji.

Overall, the new skeleton from Waya Island, Fiji, shares a number of morphological similarities with several previously described Lapita-associated skeletal series as well other skeletal series not associated with the cultural complex from Fiji, Tonga, and elsewhere in the Pacific. Broader comparisons, although limited, suggest an ancestral homeland in island Southeast Asia and in the region neighboring the southern coast of China.

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