INTRODUCTION

In this chapter we present a brief chronological history of paleopathology in the Pacific, highlighting key individuals who have contributed to the study of disease in this vast ocean world. Unlike other regions covered in this volume, the sheer enormity and relative isolation of many of the islands of the Pacific further warrants that we consider national as well as regional variables that have influenced these contributions to paleopathology.

As is the case for other areas of the world, the availability and access to human skeletal collections has been greatly influenced by the history of early collecting expeditions, museum accessions, archaeological excavations, and more recently, Cultural Resource Management (CRM) work involving modern development and construction projects. The relatively recent exploration and settlement of the Pacific has also influenced research initiatives in bioarchaeology. Because the oldest occupied regions of the Pacific did not receive their first modern human inhabitants until approximately forty to fifty thousand years ago and the remainder of the Pacific was void of human presence until less than 3,000 years ago, physical anthropologists have tended to focus more on the origins of these colonizers rather than on issues involving health and lifestyle of Pacific Islanders.

As physical anthropologists studied the complex histories of settlement and exploration, they also documented the uniqueness of these island environments—their physical isolation, constrained resources, severe climate events, and so on. Research in some regions of the Pacific, such as the remote island arcs of Central East Polynesia, is beginning to suggest that the combination of late colonization (Hunt and Lipo 2006; Tuggle and Spriggs 2002), and relative (if not complete) isolation (Brewis et al. 1990; Kirch 1989) has generated unique island historical trajectories that approach the conceptual ideal of the “island as laboratory” criteria for human population studies. For physical anthropologists working in the Pacific, however, the theoretical importance of islands as laboratories for assessing the dynamic, long-term relationship among health, culture, and environment may never be fully realized given the difficulties of studying human remains from this region. Such limitations, as discussed in this chapter, include the nature of salvage archaeology and skeletal analysis, repatriated skeletal collections, and increasingly stringent local regulations on studies of human skeletons, among others.

PACIFIC ISLANDS: GEOGRAPHY AND PREHISTORY

With tremendous variation in size and diversity, as many as 7,500 Pacific Islands span one-third of the Earth’s surface and thus comprise the world’s largest assemblage of islands (Lobban and Scherer 1997). Our survey will cover the three traditionally recognized geographical groups of tropical Pacific islands (sometimes also referred to as Oceania): Melanesia, Micronesia, and Polynesia. Although this tripartite classification, first introduced by the French voyager Dumont d’Urville (1832), is based on a faulty perception of Pacific Island culture history, these labels have become entrenched in anthropology (Kirch 2000). For that reason we retain them mainly as geographical referents. This chapter will therefore focus on studies of the inhabitants of the islands east of the Lesser Sunda Islands (Nusa Tenggara) of Indonesia, beginning with the Molucca Islands and Irian Jaya (eastern New Guinea) and extending east, north, and south into the Pacific (see Figure P.1, map of world with islands). From the perspective of prehistory and historical linguistics, archaeologists have further divided the Pacific into Near Oceania (comprising the islands of New Guinea, the Bismarck Archipelago, and the Solomon Island chain), and Remote Oceania, which comprises all of Micronesia, and the Melanesian archipelagoes of Vanuatu, Loyalty
Islands, New Caledonia, Fiji, and Polynesia (Green 1991). Humans began entering the western margins of Near Oceania approximately forty to 50,000 years ago, crossing Wallace’s Line from Southeast Asia into the ancient continent of “Sahul” (consisting of New Guinea, Australia, and Tasmania). From there, they expanded to occupy Sahul and all of Near Oceania and regions as far as the main Solomon Islands by 35,000 BP (Kirch 2000). Much later, at approximately 3,500 years before present, a major expansion of Austronesian-speaking people resulted in the relatively rapid spread of humans beyond the Solomon Islands into Remote Oceania, associated with the archaeological horizon known as Lapita (Kirch 2000). After a period of perhaps as many as 1,000 years, eastern Micronesia and eastern Polynesia were settled between 900 BC and AD 1000. The very first human settlers probably did not reach some of the most remote regions of Polynesia (e.g., Easter Island, Hawaii, and New Zealand) until approximately AD 1200 (Hunt and Lipo 2006).

Our chapter begins with initial observations and descriptive reports of paleopathology using human skeletons (primarily crania) collected during the age of scientific expeditions to the Pacific (1840–1900). Work at the beginning of the 20th century (1900–1950) continued using museum collections but with the addition of a small number of excavated human skeletal series. After World War II (1950–1980), more evaluative comparisons of paleopathological evidence emerged. We conclude with the most recent work encompassing both individual and population aspects of paleopathological description, diagnosis, and paleoepidemiology that continues into the 21st century in some regions of the Pacific. Short biographies of eight key individuals further illustrate some of the major contributions and thematic developments of paleopathology in the Pacific.

EARLIEST STUDIES:
1840–1900
Initial descriptions of excavated human skeletal remains from the Pacific, including some of the first observations of paleopathology, were made by individuals trained as medical doctors, anatomists, and naturalists, using the large numbers of skeletal remains, primarily crania, found in museums in Europe, the United States, and the Pacific. For example, more than 2,000 crania from New Guinea alone are found in museums around the world (Pietruszewsky 1976, 1983, 1986, 1990a). Many of these collections were the result of the great expeditions to the Pacific that began in the 18th century, expeditions that acquired a vast array of floral and faunal (including human) material. Such explorations, mainly European, continued well into the early decades of the 19th century, along with the appearance of additional collectors of human skeletal remains in the form of traders, missionary groups, and imperial colonizers from Britain, France, Germany, United States, and Japan. Skeletal remains accumulated by these disparate means typically have the barest of provenance, or good preservation, and are subject to many and various biases (e.g., incomplete skeletons, sample error, collector’s bias). Two early descriptions of crania and skeletons from the Pacific are William Turner’s (1884, 1886) study of skulls that were collected during the voyage of H.M.S Challenger (1873–1876) and Emil Zuckerkandl’s (1875) descriptions of crania from Africa, South America, Southeast Asia, and the Pacific collected during the Austro-Hungarian scientific Novaera-Expedition (1857–1859). These were two of the last great scientific expeditions of the 19th century to produce reports with such broad and deep coverage. Printed catalogs are another source of early descriptions of human skeletal remains (e.g., Davis 1867, 1875; Escher 1878; Flower 1879; Schaafhausen 1878; Schmelz and Krause 1881; von Luschan 1907). The catalogs, which sometimes included items for sale, itemized and described anatomical collections that had been donated or otherwise acquired by museums and private individuals, mainly in Europe (see the biography of Joseph Davis, below). Today, often relegated to the rare book sections of libraries, they serve as valuable sources of information on the provenance of these collections and early descriptions of disease. These publications concentrated mainly on cranial morphology and detailed metrical descriptions for reconstructing human “racial” history and sometimes included observations of paleopathology. Extensive comparisons of crania from newly discovered regions provided the Western scientific community with its first glimpses of new and exotic people.

Joseph Barnard Davis (1801–1881)
Born in York, England (1801), Joseph Barnard Davis amassed an extensive, global collection of human skulls, including many from the Pacific. During his long career as a medical practitioner in a small Staffordshire town (Anonymous 1881), he assembled one of the largest 19th-century collections of human skulls (more than 1,500), procured through private purchases and donations. Following Davis’ death in 1881, the collection
was donated to the Royal College of Surgeons of England in London and subsequently transferred to the Natural History Museum, London, at the end of World War II.

Davis published numerous papers on anthropological topics, including his influential *Thesaurus Craniorum* (Davis 1867), a valuable catalog featuring descriptions of skulls of various “races” represented in his collection along with a vast number of measurements (well over 25,000) and literary references. Several sections of *Thesaurus Craniorum* are dedicated to crania from the Pacific, the largest series representing Hawaii (139), Marquesas (30), New Zealand Maori (14), and the Loyalty Islands (12). In the Maori sample, Davis described evidence of cranial fractures, extensive tooth wear, and dental caries. In reporting on the 139 crania from Hawaii, Davis extended his observations to include not only tooth wear and caries, but also auditory exostoses (for which no cause was given), cranial modification, antemortem tooth loss due to “tooth knocking” (tooth ablation), and other conditions.

Other early brief notations of paleopathology include those by William Henry Flower (1831–1879). Flower, in describing eight Maori skulls in the Royal College of Surgeons, London, noted that one of the skulls exhibited a mandibular condyle with severe “chronic rheumatic arthritis” (osteoarthritis) (Flower 1879:131). A cranium from New Caledonia was also said to present evidence for “rheumatic arthritis” of the temporomandibular joint (Flower 1879:204), while eight crania from one of the Vanuatu Islands (Malekula) and one cranium from Torres Strait Islands were described as having been artificially modified (Flower 1879:214, 220). One of Flower’s more vivid examples of perimortem paleopathology was his description of a skull from the interior part of the largest of the Fijian Islands, Viti Levu: “The blow, inflicted just behind the left parietal eminence, has completely detached a nearly circular piece of the inner table of the skull about the size of a shilling.” (Flower 1879:209)

Overall, however, descriptions of Pacific crania at this time did not mention pathological changes. With the possible exception of a few brief comments concerning artificial cranial modification or dental caries, most early studies—even those by medical professionals—neglected to report pathological conditions (e.g., Udhe 1861; Retzius 1864; Weckler 1866; Pruner-Bey 1864–1867; Spengel 1873, 1874, 1876; Meyer 1875; Krause 1881; Quatrefages and Hamy 1882; Turner 1884, 1886; Prochownick 1887; Mollison 1908).

Although these initial reports about paleopathology in the Pacific, made by people who had never traveled there, were largely anecdotal in nature and tended to focus on unusual findings such as tooth ablation and cranial modifications, there were a few exceptions. For example, Weckler’s (1888) pioneering comparative study of cribra orbitalia in crania in European museum collections included examples from the Pacific Islands. Similarly, reports by two 19th-century American researchers on Hawaiian crania, Jeffries Wyman and Harrison Allen (see biographies below), foreshadow later contextualized and problem-oriented approaches. The first full description of New Zealand Aborigines using a large skeletal series actually in New Zealand was published by John Scott (1893; see biography below).

**Jeffries Wyman (1814–1874)**

Jeffries Wyman, an anatomist, naturalist, and a pioneer of American anthropology, was born on August 11, 1814, in Chelmsford, Massachusetts. As a child, Wyman was drawn to natural history and pure science, which influenced his research in his formative years. After attending Phillips Exeter Academy, he went on to graduate from Harvard College, Massachusetts, in 1833 despite suffering from severe pneumonia in his senior year, a condition that would affect him throughout life. With the death of his first wife Adeline Wheelwright, with whom he had two daughters, Molly and Susan, he married Anna Williams, who died after giving birth to their son, Jeffries Wyman, Jr., in 1864. Several memoirs of Jeffries Wyman’s life and work have been published (Packard 1878; Wilder 1910). These and other publications (e.g., Hrdlicka 1914; Jarcho 1966; Brown 2002; Cook and Powell 2006) are the source of information covered in this section.

**Professional Career**

After receiving his medical degree from Harvard in 1837, Wyman opened a private practice and also served as demonstrator of anatomy for Harvard Medical School under the supervision of John C. Warren. Later, as curator for the Lowell Institute in Boston, he presented a distinguished series of twelve lectures on comparative anatomy and physiology (1840 to 1841). He used fees from these lectures to further his studies in Europe, especially Paris, where scientists were instrumental in formulating the beginnings of physical anthropology. Upon his return to the United States from Europe, Wyman taught for several years at Hampden-Sidney College in Richmond, Virginia,
before assuming the position of Hersey Professor of Anatomy at Harvard College in 1847, where he remained until his death in 1874. During his lectures at Harvard, Wyman often used his own anatomical sketches, which were drawn with great precision and detail. From 1866 to 1874, while he was teaching at Harvard College, Wyman became a trustee and then the first curator of the newly established Peabody Museum in 1866, one of the world’s oldest museums devoted to archaeology and ethnography. Wyman was also active in several professional societies, including serving as president of the American Association for the Advancement of Science.

Wyman’s earliest research, reported primarily as abstracts and unpublished manuscripts, focused on the osteology of great apes and humans. His later work concentrated on the morphological observations of crania. His two publications on paleopathology of skeletal remains from the Pacific included a short paper on the distorted skull of a child from the Hawaiian Islands (Wyman 1866–1868a) and the description of a series of crania collected from a sand dune on the Hawaiian island of Kauai (Wyman 1866–1868b). In describing twenty-one crania from Kauai, he devoted several pages of text and tables, and described the development of bony nodules in the auditory meatus in four crania (auditory exostoses), which he attributed to activities involving water, as well as several dental anomalies such as small teeth (microdontia/peg-shaped teeth), tooth retention in the alveoli (impacted teeth), absence of the wisdom teeth or third molars (agenesis), and rotation of the premolars. As Ubelaker (1982) observed, Wyman’s comparative study of auditory exostoses in prehistoric Peruvian and Hawaiian crania (Wyman 1868) was the first study by an American to take an explicitly comparative population approach to understanding abnormal lesions in ancient populations.

Overall, Wyman’s work was novel and noteworthy. He introduced an innovative comparative approach to systematic observation, including observations and interpretations of paleopathology. Before he died from pulmonary hemorrhage on September 4, 1874, at the age of sixty, Wyman expressed his intention of furthering his research on the paleopathology of the Hawaiian Islands residents. Many years after his death, Wyman’s letters (1866–1874) written to his only son, Jeffries Wyman, Jr., were published in one volume (Gifford 1978). The letters reveal Wyman’s clever attempt to instill the concept of keen observation and curiosity in his son through his descriptions and drawings of places he had encountered during his journeys away from home for health reasons.

Harrison Allen (1841–1897)
Another pioneer in the study of paleopathology in the Pacific was Harrison Allen, born on April 17, 1841, in Philadelphia (Wilder 1898). As a child, Allen had a profound interest in natural history and science, which continued during his adult years. Even though his family was not affluent, he pursued a degree in medicine, including dentistry, at the University of Pennsylvania. There Allen had the good fortune to study with Joseph Leidy (1823–1891), a renowned paleontologist, anatomist, and anthropologist, and a protégé and successor of Samuel Morton (1799–1851), one of the pioneers of American physical anthropology. In 1869 Allen married Julia A. Colton by whom he had a son, Harrison, and a daughter, Dorothea. Allen died from heart failure on November 14, 1897, at the age of fifty-six.

Professional Career
After receiving his medical degree in 1861, Allen served as a physician and surgeon in the US Army in Washington, DC, until 1865. The remaining thirty-one years of his career were spent at the University of Pennsylvania, where Allen served as a professor of zoology, comparative anatomy, and physiology. He was also appointed the first curator of the University of Pennsylvania’s Wistar Institute of Anatomy in 1893.

Allen authored numerous monographs, papers, and books including A Study of Hawaiian Skulls (Allen 1898), which includes observations of paleopathology. This study of sixty-five skulls collected from Hawaiian caves and coastal locations and curated in various museum collections at the Academy of Natural Sciences in Philadelphia, Princeton University, and Harvard University is among the earliest studies of human skeletal remains from the Hawaiian Islands. Allen’s observations of paleopathology were most detailed and extensive for the time, including descriptions and selected line drawings of examples of osteoporosis, ostetis, hyperostosis of the mandibular condyle, defects of the maxilla, premature suture closure, auditory exostosis, enamel defects, and dental anomalies such as absence of the third molar and extra cusps (Figure 63.1). Using skull measurements and "characteristics" (including paleopathological ones), Allen contrasted the cave skulls (presumed to be nobility) with the coastal skulls (presumed to be commoners) and found differences in both datasets. Allen was primarily interested in how
a particular disease affected cranial morphology rather than the disease itself, concluding that nutritional deficiencies, environmental changes, and cultural modifications rather than "race"—a common explanation of the time—likely explained many of the conditions he described.

John Halliday Scott (1851–1914)
An early pioneer in the field of osteometry who also contributed to our early understanding of paleopathology in the Pacific was the Scottish anatomist John Halliday Scott. Scott, the son of a writer, was born in Edinburgh, Scotland, on December 28, 1851 (Allen 1997; Wright-St. Clair 2007). He received his MD degree from the University of Edinburgh in 1877. After serving as a house surgeon in Edinburgh and Stirling, and teaching within the Department of Anatomy at the University of Edinburgh, Scott left Edinburgh in 1877 to take a position as professor of anatomy and physiology at the University of Otago in New Zealand. He later became the first dean of Otago Medical School, a position he held until his death on February 25, 1914. In addition to his devotion to the medical school, Scott also had a great interest in art and anthropology. A gifted water color artist, he was active in the art community and served as secretary of the Otago Art Society. Many of his paintings of nature are still displayed in museums today (Wright-St. Clair 2007). He also drew many anatomical diagrams for use in teaching.

Professional Career
Scott revealed his attraction to physical anthropology, and especially osteology, through his teaching, his skeletal collection, and through his monograph, Contribution to the Osteology of the Aborigines of New Zealand and Chatham Islands (Scott 1893), in which he published the first comprehensive study of approximately eighty Maori and Moriori skeletal remains located in museums and private collections in New Zealand. Although Scott's main focus was morphology and measurement, he commented on the absence of dental caries and auditory exostoses, and noted several examples of alveolar abscesses and tooth wear. Scott observed that some of the Maori mandibles were "convex from behind forward" (Scott 1893:37), a unique morphology that would later be given the name "rocker jaw," and he made the first observations of squatting facets in tibiae and tali of Pacific Islanders (Scott 1893:59). Scott's early contribution to osteology and paleopathology stands as a landmark study of Pacific skeletal series because it included all the bones of the skeleton rather than just crania. Unfortunately, he did not systematically quantify his observations of paleopathology.
as he did for the other morphometric variation he observed.

In summary, early work in paleopathology in the Pacific was highly descriptive, often anecdotal in nature, noting unusual conditions such as tooth ablation, cranial modification, and dental disease observed in crania. The skeletal remains, primarily stored in major museum and university collections found in Europe and the United States, frequently resulted from the great scientific collecting expeditions and early trading typical of this period. The major interest in physical anthropology was cranial morphology and "racial" history. While the morphometric work of Scott on Maori and Mori crania is exceptional for its time, paleopathology enjoys only passing mention in his landmark study. In contrast to these primarily typological studies, the works of two early American pioneers, Jeffries Wyman and Harrison Allen, are exemplary because they not only provided the earliest careful systematic observations of paleopathology in skeletal remains from Hawaii but they began to speculate on the interaction of disease, culture, and the environment. Allen's work is also particularly noteworthy as it was one of the first comparative studies in the Pacific.

**EARLY 20TH CENTURY (1900–1950)**

With the exception of two pioneering dental studies, there was little work in human physical anthropology for the Pacific during the first half of the 20th century. This absence occurred, in part, because systematic stratigraphic archaeological excavations in the Pacific were rare until after World War II and also because physical anthropology's focus was primarily on somatological studies of living peoples. Of course, museum studies in craniometry continued (e.g., Duckworth 1900; Thomson 1915; von Bonin 1931) but again, the emphasis was on reconstructing "racial" history and exploring cranial modification (Giuffrída-Ruggeri 1921; Pearson 1921; Thomson 1915). However, works by two dentists, Henry Chappell and Rufus Leigh, are exceptional for their systematic appraisals of dental anthropology, including oral-dental paleopathology. Both contributions were the result of studies of skeletal remains accessioned in the Bernice Pauahi Bishop Museum in Honolulu. The museum, established in 1891, began assembling artifacts and human skeletal remains donated by residents, collected from the surface of eroding sand dunes, and uncovered during military construction and operations.

**Henry G. Chappell (1868–1941)**

We know very little about the life of Henry G. Chappell except for the information provided by Californian death records and the 1900 US Federal Census Records. He was born on March 20, 1868, in England. After emigrating to the United States as a child in 1873 Chappell went on to earn his Doctor of Dental Surgery degree (DDS), before setting up a dental practice in Oakland, California. His sole contribution to the fields of physical anthropology and paleopathology resulted from a brief visit to Honolulu in 1920. Chappell died on September 13, 1941, at the age of seventy-three.

**Professional Career**

In addition to his dental practice, Chappell served as president of the California State Dental Association from 1911 to 1912. With the support of the museum's director, Herbert E. Gregory, Chappell examined native Hawaiian crania and mandibles in 1920, and his monograph, *Jaws and Teeth of Ancient Hawaiians*, was published by the Bishop Museum in 1927 (Chappell 1927). In addition to detailed metrical and nonmetrical descriptions, he made systematic notations of cultural modifications, lack of tooth development, dental disease, and other anomalous features. Chappell's study is the first comprehensive investigation of ancient Hawaiian dentitions, including prevalence rate comparisons between the sexes and the islands, photographs, and individual raw data. In using his personal knowledge as a practicing dentist, Chappell noted that the ancient Hawaiians had experienced the same dental diseases that were found in living people. Chappell also drew correlations between dental disease and the diet of ancient Hawaiians. This is probably the only detailed documentation of these crania made before they were repatriated and forever lost to science.

**Rufus Wood Leigh (1884–1964)**

Rufus Wood Leigh was born on December 18, 1884, in Cedar City, Utah (http://www.rootsweb.ancestry.com/). In September of 1920 he was commissioned as a First Lieutenant in the US Army Dental Corps. Leigh subsequently went on to earn his MA degree in anthropology at the University of Hawaii in 1930 under the supervision of Frederic Wood-Jones who, from 1927–1929, was the Rockefeller professor of physical anthropology at the University of Hawaii. Leigh died a few months short of his eightieth birthday on August 24, 1964, in Salt Lake City, Utah.

**Professional Career**

In addition to serving as a captain in the US Army Dental Corps, Leigh taught pathology in the Army
Dental School and Georgetown University Dental School in Washington, D.C. Later, Leigh went on to teach at the University of Utah. Leigh was a pioneer in the field of dental pathology, examining dental health and diet within cultural contexts (Cook and Powell 2006:295; Rose and Burke 2006:331). His primary contribution to paleopathology in the Pacific was his monograph on Chamorro teeth published as a memoir by the Bishop Museum (Leigh 1929), which he also used to complete his requirements for an MA degree (Leigh 1930). The human skeletal remains that Leigh studied, the so-called Hornbostel Collection, came from archaeological excavations in Guam undertaken in 1922 by J.C. Thompson, an officer in the US Navy, and Mr. Hans G. Hornbostel, a retired US marine, for the Bishop Museum in Honolulu. Leigh's study included the first observations of dental morphology and disease in skulls from pre-Spanish to early post-Spanish contact Guam. For his time, Leigh's work was very thorough, scoring the presence and absence of disease by tooth, and analyzing percentages of individuals affected by specific conditions. The effects of chewing betel nut were well documented. Leigh's several publications (1929, 1930) linked dental health and disease to the diet of the prehistoric Chamorro of Guam. He also noted cultural modifications and deformations that could lead to dental disease, such as incising of teeth to make latticed patterns, which would hold betel nut stains. Leigh published his work in both dental and anthropological journals, underscoring the value of each discipline to the other.

As was the case in the preceding period, work in paleopathology in the first half of the 20th century in the Pacific was largely overshadowed by anthropometric studies. Work by two dentists visiting Hawai`i, Chappel and Leigh, produced the first monographs on dental anthropology that included systematic observations of oral-dental disease, dental modification, and the relationship between dental disease and diet. Papers dealing specifically with pathology using excavated skeletal series with controlled provenance, or even discussions including whole individual skeletons, were still elusive for this period.

AFTER WORLD WAR II (1950–1980)

After World War II physical anthropology, including paleopathology, in the Pacific region was transformed by an increasing availability of archaeological human skeletal remains from well-stratified excavations and the use of the radiocarbon dating for temporal control (vital for the elusive stratigraphy of sand dunes). At first confined mainly to Polynesia, controlled excavations of stratified sites, often containing human skeletal remains, eventually expanded to include Melanesia and Micronesia. For the first time, sizable cemetery series of human skeletal remains from places such as Tonga, Hawai`i, Marquesas, Easter Island, and New Guinea were now available for study (Table 63.1). These collections were curated in museums across the Pacific (e.g., Bishop Museum in Honolulu, Auckland Museum and Institute in Auckland, New Zealand, and elsewhere). Although the first full-time academic physical anthropologist was hired by the University of Hawaii in 1969, studies of paleopathology were still carried out by dentists and medical doctors such as Morris Taylor at the University of Auckland and Philip Houghton (see biography below) at the University of Otago in New Zealand. Gradually, however, physical anthropologists, in collaboration with other specialists, began to predominate. With very few exceptions, however, observations of paleopathology were commonly treated in separate sections of larger systematic archaeological site reports.

An early publication from this period that focused exclusively on paleopathology was by T. D. Stewart (Chapter 15) and Spoehr (1952). Their report described the first paleopathological example of yaws in a single pre-contact (pre-1521) subadult individual from Tinian, in the Northern Mariana Islands. Radiocarbon dating suggests this individual dates from AD 845±143 years, establishing significant antiquity for this modern endemic illness, and establishing the pre-contact context of yaws in the ongoing debate on the history of the treponematoses. The long limb bones and skull in this incomplete skeleton were exquisitely documented through measurement and careful description, with supplementary photographs and radiographs. Although there is no systematic discussion of differential diagnosis, an attribution of yaws versus venereal syphilis relied primarily on the pre-contact temporal position of the burial, the subadult age, and the first author's background in medicine and paleopathology. This study also stands out because the skeletal remains resulted from a deliberate, stratigraphically controlled excavation, with temporal and spatial control, and all of the available bones of the skeleton were utilized. At this time, “case studies” such as these were the norm. There were few epidemiological or population perspectives, examinations of pathological processes in other parts of the skeleton, or recognition of signs of biological "stress." This paper therefore stands as an example of the
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kind of thorough, "by element" descriptions of disease in an individual skeleton that are still being called for today (Ortner 1991, 2003). With this depth and detail of description, any reader today can render an opinion on the suggested diagnosis, rather than having to rely on the experience and judgment of the recorder.

Accidental discoveries and several major salvage excavations at the Mōkapu sand dunes on the island of Oahu resulted in more than 1500 Hawaiian burials accessioned at the Bishop Museum in Honolulu. A comprehensive study of these skeletons, including extensive descriptions of paleopathology, was conducted between 1951 and 1957 by Charles Snow, (see biography below), with the assistance of his wife, Katherine, but the results were published posthumously (Snow 1974). During his study Snow worked with Warner F. Bowers, a practicing military surgeon stationed in Hawaii (Bowers 1966); each acknowledged the collaboration, but Snow commented that his observations were offered "from the viewpoint of an anthropologist" (Snow 1974:60).

Bowers' (1966) summary of pathological and functional changes in 864 pre-1778 Mōkapu skeletons stands as the first study of ancient disease using a large sample of skeletal remains from the Pacific. Until other large skeletal series were excavated and analyzed, this study represented a unique, significant overview of paleopathology in skeletons from a single Hawaiian archaeological site. Use of radiography, classifications of disorders based on osseous processes, and reporting data by the number of bone elements affected, compared to those observed, rather than by individuals affected regardless of preservation, characterized this forward-looking study. Unfortunately, because this was a summary article, much of the detailed descriptive information on the abnormal findings is absent.

Charles Ernest Snow (1910–1967)

Charles Ernest Snow was born on April 11, 1910, in Boulder, Colorado. Snow was an enthusiastic photographer, a skill he learned from his father, who was a professional photographer. He attended the University of Colorado, Boulder, and graduated with a BA in Geology with honors in 1932. He was later accepted into Harvard graduate school, where he studied physical anthropology under Earnest A. Hooton, (Chapter 24), receiving his MA in 1935 and his PhD in 1938. While working on his doctorate, Snow worked as an assistant anthropometrist on the Child Measurement Project for the Bureau of Home Economics, U. S. Department of Agriculture (Bass 1968; Bridges 1997). After graduation from Harvard, Snow accepted a position as physical anthropologist with the Works Progress Administration (WPA), Tennessee Valley Authority Archaeological Project in Birmingham, Alabama, which was part of Franklin D. Roosevelt's New Deal relief program during the Great Depression (Milner and Jacobi 2006). Snow and his colleagues stressed the importance of standardized measurements so that comparisons could be made in the future. A great many of his future papers and research cover the human skeletal remains recovered in this project. The project was closed with the beginning of World War II, and Snow was offered a position in the Department of Anthropology at the University of Kentucky, where he remained until his untimely death on October 5, 1967.

Professional Career

Following World War II, Snow served as an anthropologist for the American Graves Registration Service (AGRS) at the Central Identification Laboratory on Oahu, Hawaii, for six months in 1947 and 1948. It was while serving with the AGRS on an errand to the Bishop Museum that Snow learned of the Mōkapu burials (Snow 1974:1). During the summer of 1952 Snow returned to Honolulu to study the remains of 1,171 individuals who were exposed during excavations at Mōkapu, Oahu. The results of his study were published posthumously by his wife, Katherine B. Snow, in 1974 (Snow 1974). In addition to describing examples of cranial deformation and rocker jaw in these remains, Snow provided detailed observations of pathological conditions in one chapter (e.g., healed fracture, an amputation, "lopsided" skulls (wryneck syndrome), osteoarthritis, club feet, and dental pathology). He made observations of living native Hawaiians, showing methods of cranial modification, and he included comments by eminent native historians of the time. Also included in this seminal work in Hawaiian osteology was an appendix detailing a number of paleopathological examples from Mōkapu by Johnson and Kerley (1974). This collection greatly added to the number of skeletal remains that were studied in Hawaii, and Snow's photographs, recorded measurements, and observations continue to be of great value as the skeletons have been repatriated.

Additional work following World War II illustrates how paleopathology was beginning to develop further. A "preliminary" report by Jane Hainline Underwood (1969) provided a fairly comprehensive overview of the skeletal biology of ninety-seven individual burials from the
South Point site on the island of Hawaii, but also captures some of the difficulties of “salvage” and even research-oriented archaeological work in the Pacific for this time period. Underwood, from the University of California Los Angeles (UCLA), despite spending only two weeks analyzing the skeletons, presented a rather inclusive overview of the skeletal biology of these remains but laments that there was no “detailed archaeological analysis of the site” (Underwood 1969:13). Another shortcoming of this early work was the lack of individuals trained in paleopathology: “the causes of death in the sample are not evident, although examination by a qualified paleopathologist may dispel some of this ignorance” (Underwood 1969:5).

Furthermore, a representative example of a study that includes a separate section (Chapter V in Murrill 1968) on paleopathology in archaeological human remains from Easter Island is anthropologist Rupert I. Murrill’s study of thirty-three adult skeletons recovered from Thor Heyerdahl’s 1955–1956 Kon-Tiki expedition (Murrill 1968). Although Murrill’s study focused primarily on metrical and nonmetrical observations, and focused on questions of origins, one brief section (a single page of text and another page showing photographs) was devoted to observations of paleopathology (e.g., osteoarthritis, rickets, healed fracture, tuberculosis, and possibly yaws). Murrill used radiographs, and acknowledged the assistance of an orthopedic surgeon in assessing and interpreting the conditions discussed.

A further early paper by Pietrusewsky (1969a), which was part of his doctoral dissertation (1969b) research, summarized skeletal morphology and paleopathology in human skeletal material from two prehistoric burial mounds (To-At-1 and To-At-2) on the island of Tongatapu, Kingdom of Tonga. The material was the largest skeletal series excavated in the South Pacific at that time and thus provided the first opportunity for skeletal description of Western Polynesians. Pietrusewsky introduced “burial descriptions” that summarized morphological details about each individual skeleton. A great deal of attention was given to observations of paleopathology, including systematic observations of dental pathology, degenerative changes on the articular surfaces of the long bones and axial skeleton, and evidence for trauma and infection. Explanations of pathology included all affected elements in each individual using systematic, descriptive terminology, followed by attributions to specific diseases (e.g., treponematoses). The studies were augmented with liberal photographs and radiographs of the affected elements.

Although this was one of the first large-scale skeletal analyses by a young physical anthropologist, it is evident that the research was undertaken with attention to detail and with an effort to document the skeletal series in full, including paleopathological evidence. This is likely the first computerized analysis of skeletal morphology and paleopathology, and the first fully published description of a large archaeological skeletal series in the Pacific. The author provided visual, radiographic, and textual descriptions of the abnormal bone changes and provided individual, as well as a population, context for diseased individuals. For this period and in a region of the world with little or no ongoing skeletal research, this was a commendable effort. This paper established the standard for skeletal analysis in the Pacific. One of the more remarkable findings of this early study was the description of lesions consistent with a diagnosis of yaws in thirteen adults, the largest number of individuals affected in a skeletal sample from the Pacific.

Philip Houghton (1937–

Philip Houghton was born on May 14, 1937. He received his degrees in medicine and surgery (MB and ChB) in 1960 from Otago Medical School and became a fellow of the Royal Australasian College of Surgeons (FRACS) in 1969 from the University of New Zealand. After working as house surgeon at Christchurch Hospital, Houghton served three months in 1963 as a medical officer helping Sherpas for Sir Edmund Hillary’s Himalayan Expedition (Zega 2006).

Houghton served as a demonstrator of anatomy at Otago Medical School, and then spent four years (1965–1969) as a practicing surgeon in various posts in Christchurch, Auckland, and in London. In 1970 he led a surgical team as part of the British Ministry of Overseas Development in Nigeria during the Nigerian-Biafran War, and in 1971 through 1972 was part of the New Zealand surgical team in Vietnam during the Vietnam War. Beginning in 1973 Houghton taught anatomy at the University of Otago, where he remained until his retirement in 1997. It is during this period that he contributed greatly to Pacific physical anthropology. In addition to his academic work, Houghton published a novel (1966), and several natural history and adventure books (e.g., Houghton 1968, 1972).

Professional Career

Houghton’s primary interest was in the human biology of the Pacific, including phenotypic adaptations of Polynesians and the health of the
prehistoric New Zealand Maori. He published
two books and numerous papers on the subject.
Houghton discussed the physique and head form
of the Maori, and also included separate chapters
for demography and disease. Large sections of his
book *People of the Great Ocean* (Houghton 1996)
are devoted to supporting his theory that the rig-
ors of long-distance voyaging contributed to the
skeletal morphology and health of the Maori and
Pacific Islanders seen today. The strong program
of research in the skeletal biology of the Pacific
initiated by Houghton at Otago, which followed
the earlier work of Scott (1893) and Schofield
(1959), continues with the work of Nancy Tayles,
Hallie Buckley, and Sean Halcrow of the same
department.

It is during this period after World War II that
papers focusing exclusively on paleopathology in
Pacific skeletal remains begin to appear although
they do not extend much beyond careful case
studies and diagnosis. With the onset of systematic
archaeological excavations in the Pacific, there was
a virtual “explosion” in the number of reports con-
taining observations of paleopathology, notably
in Polynesia and Micronesia. These reports often
contain detailed systematic descriptions of disease
in skeletal and dental remains, often supplemented
with radiographs, photographs, and interpreta-
tions by pathologists, radiologists, and orthopedic
specialists.

**RECENT STUDIES: 1980–PRESENT**

With some exceptions, studies in paleopathology
beginning in approximately 1980 to the present in
the Pacific have been driven by the availability of
human skeletal remains from archaeological excava-
tions (e.g., for Hawaii large skeletal series such as
Keōpū, ‘Anaebo’omalu, and Honokahua), and
most noticeably the boom in archaeological con-
tract work by CRM firms (created by federal legis-
lation). The inherent nature of CRM work (budget
and time constraints, multiple investigators, inter-
observer error, reburial of the skeletal remains,
and other variables) contributes to the relegation
of osteological and paleopathological data to the
appendices of archaeological site reports, which
results in a lack of integration between the people
and their context. Additionally, although skeletal
data from site reports contribute to the expand-
ing database in paleopathology, these reports
are typically unpublished “gray” literature (e.g.,
Pietrusewsky et al. 1989, 1990a, b, c; Roberts and
Cox 2003).

Likewise, considerable variation in the level of
reporting paleopathological conditions exists
for this recent period, with a tendency to empha-
size a specific diagnosis rather than provide fuller
descriptions of the conditions. Additionally, there
is the propensity to report unusual conditions
(e.g., cranial deformation, rocker jaw, dental mod-
ifications) or to report the “first ever case of” from
the Pacific, or anticipate the origin and introduc-
tion of certain infectious diseases (e.g., leprosy,
yaws, tuberculosis) into the Pacific (e.g., Miles
1997; Trembly 1995a, 1996a). The use of photog-
raphy, radiography, and other analytical methods
also became increasingly common in this period.
While many of the descriptions of paleopathology
are included in skeletal reports (the gray litera-
ture), there is a noticeable increase in the number
of journal articles and book chapters that focus
on paleopathology over the past four decades
(Table 63.2).

At the University of Hawaii, work by
Pietrusewsky and his students (and later col-
leagues) began a tradition of systematic record-
ing of skeletal data, including paleopathology,
work that would provide an important source of
information for some of the first surveys of health
and disease in the Pacific. Examples of these early
surveys include diachronic and regional syntheses
that use indicators of health from skeletal remains
from Hawaii (Pietrusewsky and Douglas 1994) and
the Mariana Islands (Pietrusewsky et al. 1997a). It
is also during this period that the first symposia
devoted to bioarchaeology and paleopathology in
island ecosystems, such as the one organized in
1995 by Hanson and Pietrusewsky on bioarchaeo-
logical research in the Mariana Islands, appear
(Hanson and Pietrusewsky 1997).

Another focus of bioarchaeologists during this
period has been the importance of prehistoric mor-
tuary practices and human biology, demonstrated
in the CRM-based work in Mariana Islands by
Douglas Hanson (Hanson 1987, 1989) and the use
of subadult skeletal remains in studies of growth and
development (e.g., Stodder 1997; Buckley 2000).
Likewise, more attention to differential diagnosis
and interpretation, and the integration of historical
and ethnographic information with paleopathol-
ogy, is a further characteristic of the most recent
work with Pacific skeletal remains. An excellent
example of a multiple working hypothesis approach
to differential diagnosis is the work on congenital
torticollis or wryneck in prehistoric Hawaiians by

The number of individuals working in the
Pacific further increased substantially during this
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<tr>
<th>Individual</th>
<th>Main contribution</th>
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<td>Bernardo Arriaza</td>
<td>Spondyloysis in skeletons from the Mariana Islands.</td>
<td>Arriaza 1997</td>
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<td>Hallie Buckley</td>
<td>Sudden adult health; yaws; malaria; gout; Lapita; Tonga; Taumako; Vanuatu.</td>
<td>Buckley 2000, 2006, 2007; Buckley and Dias 2002; Buckley and Tayles 2003a, b; Buckley et al. 2005, 2008; Bentley et al. 2007; Scott et al. 2010</td>
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<tr>
<td>David De Gusta and others</td>
<td>Cannibalism and mortuary practices in Fiji; post-Lapita health</td>
<td>De Gusta 1999, 2000; Kyle et al., 2009</td>
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<tr>
<td>John Dennison</td>
<td>Brief synopsis of paleopathology from a marae.</td>
<td>Conte and Dennison 1995; Kieser et al., 2001</td>
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<td>Rona Ikehara-Quebral</td>
<td>Tooth modification in dental remains from Guam.</td>
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<td>Harris J. Keene</td>
<td>Preliminary observations of paleopathology in 3,000-year-old skeletons from Palau.</td>
<td>Nelson and Fitzpatrick 2006; Fitzpatrick et al. 2008</td>
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<td>Michael Pietrusewsky et al.</td>
<td>Head form and rocker jaw.</td>
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<th>Individual</th>
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<td>Stodder et al., 1992</td>
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<td>Alice A. Storey</td>
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<td>Takao Suzuki</td>
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<td>Morris S. Taylor</td>
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<td>Diane Tremblay</td>
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<td>Edward Visser</td>
<td>Kava use in Fiji.</td>
<td>Visser 1994a, b</td>
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period, drawn by the burgeoning CRM work in Hawaii and other places in the Pacific. Key academic institutions in Hawaii, New Zealand, and Guam trained, and continue to train, bioarchaeologists. Michael Pietrusewsky (University of Hawaii) and Gary Heathcote (University of Guam), both educated in paleopathology at the University of Toronto under the direction of James Anderson, one of the pioneers in paleopathology in Canada (Chapter 34), continue this tradition in the Pacific. Philip Houghton, at the University of Otago, a surgeon and self-trained as an anthropologist, supervised Nancy Tayles who now continues that tradition in New Zealand. George Gill and his students (e.g., Douglas Owsey) at the University of Wyoming conduct work on Easter Island skeletal remains, and another contributor to the paleopathology of the Pacific, Takao Suzuki, received his doctoral degree from the University of Tokyo under the direction of Kazuro Hanihara, and continues to research past health and disease in Japan.

Except for a few skeletons associated with the Lapita horizon (ca 1500–500 BC) in places such as New Guinea, New Caledonia, Vanuatu, and Fiji, relatively little paleopathological work in the rest of the Pacific has been produced in recent years. Issues connected with the Native American Graves Protection and Repatriation Act (NAGPRA) and repatriation have challenged work in physical anthropology in the Pacific, converting it from problem-oriented studies to “salvage osteology” where a minimum amount of data is collected. In Hawaii, especially, use and access to reports, original data, photographs, and so on are now either prohibited or severely restricted by Memoranda of Agreement. Because of the current political situation, there has been a noticeable shift in research activity away from Hawaii and out into the southern and western Pacific after the early 1990s.

Despite these limitations, this most recent work in paleopathology has contributed substantially to the development of the discipline in areas of recording, quantification, and interpretation of pathological lesions, as well as providing some of the first glimpses of the health and quality of life of prehistoric inhabitants of the Pacific. Major developments in bioarchaeology, including paleopathology, in Oceania include descriptions of a group of colonizing Lapita culture people, descriptions of the first human skeletal remains excavated from Palau, and examinations of mortuary behavior, including evidence for cannibalism. Pacific bioarchaeologists continue to add more advanced techniques to the basic suite of analytical methods, including multivariate statistical analyses, aDNA, and stable isotope analyses. Although the “island as laboratory” ideal has not materialized in full, studies of paleopathology in the Pacific continue to advance our understanding of the health of the early inhabitants of this island world. This work will provide a foundation for addressing more global issues of health in the Pacific in the future.
THE FUTURE
In Hawaii and most of the Pacific, the climate in which paleopathological research is conducted has changed considerably since Sir Peter H. Buck (Te Rangi Hīroa), former director of the Bishop Museum, welcomed Charles Snow to undertake his study of the Mōkapu skeletons in 1951. Slightly more than four decades since Snow began his study, research involving human skeletal remains from Hawaii virtually ended due to restrictive legislation enacted in 1996 that effectively prohibits all examinations of any human remains dating back more than fifty years found in the State of Hawaii. Even the use of the term “paleopathology” became a lightning rod for activists to express their horror and contempt for anthropologists who wished to examine the bones of their purported ancestors. Similar scenarios played out in New Zealand, although work by physical anthropologists there was allowed to continue, albeit cautiously, with the blessing of its indigenous peoples. Examination of archaeological human skeletal remains from Easter Island, Fiji, Vanuatu, New Caledonia, Mariana Islands, and Papua New Guinea continues, often with the active support of the indigenous peoples who wish to learn about their ancestors. It is in these regions of the Pacific that we envision the continued development of the field of bioarchaeology, including paleopathology, using new collections of human skeletal remains.

For other regions of the Pacific, research will have to focus on creative uses of archived data (e.g., The History of Health Project, Steckol and Rose 2002; http://global.sbs.ohio-state.edu/western_hemisphere_module.htm) until, or if, a reversal of policy allows further research to be undertaken.

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