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ABSTRACTS FROM THESES AND DISSERTATIONS, UNIVERSITY OF OTAGO, 2006-2011

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Abstracts for theses and dissertations on topics relating to bioarchaeological research carried out at the University of Otago have been absent from recent editions of Archaeology in New Zealand. Compiled here are those abstracts. Four PhD and six MSc theses, along with two BSc(Hons), seven BA(Hons), one PGDipSci and two PGDipArts dissertations have been completed within the bioarchaeology research cluster since 2006. The PhD and MSc theses are held in both the University of Otago Central Library and the Department of Anatomy library, with the dissertations being kept exclusively in the Department of Anatomy library. To consult any of this research it is advised that you contact the relevant library.

Bowie, Sara, 2009. Osteoarthritis: How bony changes reflect on the surrounding soft tissue of the joint, and its links to palaeopathology. PGDipSci dissertation, Anatomy, University of Otago.

There are many studies that establish how osteoarthritis of a joint affects the bone. However, little has been recognised regarding how the soft tissue surrounding the bone may be affected in relation to the underlying bony changes. This is important in palaeopathology, as researchers who find prehistoric skeletons with bony changes want to know how this correlates with symptoms experienced by the individual. As no medical history can be obtained from prehistoric populations, it comes down to the individual's interpretation as to predicting how the prehistoric people were affected.

The aim of this study was to determine if there was a correlation between osteoarthritic changes in soft tissue, specifically the joint capsule and associated ligaments, and evidence of changes in the bone. Six elderly female cadaveric hands were radiographed and examined for bony signs of osteoar-

thritis using the Kellgren and Lawrence grading system. Joints of interest were the first carpometacarpal joint, and the first and third metacarpophalangeal and interphalangeal joints. Macro-dissection followed, and observations were made of any structural changes to the capsule: ligament visibility, flexibility of the joint, ease of removal of the joint capsule samples, and examination of the joint capsule histologically. The hands were macerated, and examination of the bone surfaces was carried out. The soft tissue changes were then compared to the bony changes, to see if they were correlated. One of the specimens had rheumatoid arthritis so its correlations were not included.

There were no strong correlations between the soft tissue changes to the joints. Bony changes and radiographic signs of osteoarthritis correlated well. The soft tissue changes and bony changes were then compared to see if there were any correlations. In three of the specimens the bony changes and soft tissue changes did not correlate very well, however the specimens did not have strong evidence of OA radiographically. In two specimens there was strong evidence of bony changes characteristic of osteoarthritis. These bony changes correlated to soft tissue changes when the individual changes were compared with the bony changes as a whole. However, overall, the soft tissue changes and bony changes did not correlate. This means that when examining bones from a prehistoric individual that has bony changes indicative of osteoarthritis, it should be acknowledged there may not be soft tissue changes as well. Palaeopathologists should be careful when interpreting whether osteoarthritic bony changes meant the individual suffered from dysfunction and pain.

Bradley, Amanda L., 2010. Infant and child growth in prehistoric Tonga. PGDipArts dissertation, Anatomy, University of Otago.

The main focus of this research was to assess subadult growth as a measure of the health of a Tongan population from the Pacific Islands and to ascertain whether or not there is a relationship between the occurrence of pathological indicators and delayed growth in individuals. This research was the first to attempt to assess subadult growth as a measure of health in the prehistoric Pacific Islands.

The materials used were a sample of subadult skeletal remains from the site of ʻAtele, Tongatapu, in the Kingdom of Tonga, dated to around AD 1100-AD 1250 (Burley 1998). The primary objectives of this research were to record long bone diaphyseal length as a measure of skeletal age and to record tooth length as a measure of dental age. There is a substantial amount of information to be gained through the examination and comparison of dental age and skeletal age, particularly in populations that have had very limited research. These two ages were then compared with each other for each individual to assess whether

or not there was an age discrepancy between the two. The hypothesis is that age discrepancies would be greater in those individuals with pathological lesions as a result of acute stress from disease, using data from Buckley (2000).

The results of the present study showed only slight skeletal and dental age discrepancy in those individuals around the time of transition from breast milk feeding to the consumption of solid foods and a slightly larger discrepancy in a pubescent individual. When the pathology data was compared to the growth data it was found that there was no specific relationship between the occurrence of pathology and long bone growth.

It is interpreted that this Tongan population may have been relatively unhealthy given the high prevalence of pathology within the sample. A growth study conducted by Ribot and Roberts (1996) showed similar results and suggests that the differences in skeletal and dental age are not significant and that growth lag increases as age increases but catch-up growth would have been achieved later in life (Ribot and Roberts 1996). A possible explanation for the death of those individuals transitioning from breast milk to solid foods is the synergistic effects between infection and nutrition. Those children that are solely dependent on the mother's milk will have the same nutritional intake as the mother and a similar immune system (Gordon et al. 1963). When the transition to solid food occurs the child needs to sustain the immunity that it had on breast milk. More often than not this is the period of the highest susceptibility to infection and as such many infants die from acute stress as a result of infection (Gordon et al. 1963).

In conclusion, the results of this research found that this prehistoric Tongan population was a relatively unhealthy one and contributed to the baseline of knowledge on prehistoric Pacific Islanders. There is no relationship between pathological lesions and delayed growth in the subadults in this sample. It should be taken into consideration that acute stress from disease may have been the cause of immediate death which would have prevented the accumulation of pathology on the skeleton. The contribution of growth data is important as no other growth studies have been conducted as yet in the Pacific Islands.

Browne, Patrick, 2010. Palaeopathology in four skeletons from Bronze Age 2 at Ban Non Wat. BSc(Hons) dissertation, Anatomy, University of Otago.

The site of Ban Non Wat in the Upper Mun River Valley of northeast Thailand has yielded approximately 637 skeletons, classed into 10 periods. Four of these skeletons are from Bronze Age 2 period (2850-2950 BP) and were studied for pathological change as a precursor to publishing the findings of the larger sample, with the aim of providing an in-depth understanding of these

skeletons and perhaps revealing a relationship between them. Also, an initial idea of the skeletons in the second Bronze Age period and the entire mortuary population as a whole is provided. Lastly, the significance of the possible pathologies found in these individuals is also considered in its context. For instance, Burial 571 may have had DISH or a sero-negative spondyloarthritide, Burial 570 may have had mastoiditis due to an ear infection and probable trauma, Burial 455 may have had leprosy, rheumatoid arthritis or psoriatic arthritis and Burial 445 may have had osteomyelitis or treponematosis.

Cox, Katharine, 2009. Human migration in prehistoric northeast Thailand. PhD thesis, Anatomy, University of Otago.

The aim of this thesis is to examine the scale of human migration in three prehistoric settlements in the Upper Mun River Valley (UMRV), northeast Thailand, from c. 1700 BC-AD 500. Archaeological data implies migration may have had a central role in the development of agriculture and later metal technology in the region, which is suggested to show increased social complexity over this important stage in the development of states in mainland Southeast Asia. The scale of these migrations, however, are not known and based on archaeological evidence it is unclear whether there were large numbers of individuals migrating into the region in order to bring about the changes seen in the archaeological record.

Two potentially complementary methods are used to identify the extent of migration in the UMRV in this thesis. The first method, the study of dental morphological traits, is used as an indication of genotype of 78 prehistoric individuals. The second method is isotope analysis of the dental enamel of 74 individuals, used as indicators of childhood residence and diet. Strontium (Sr), carbon (C) and oxygen (O) isotopes are analysed. The first method reflects an individual's genetic heritage through inherited traits, while the second method is an indication of an individual's migration during their lifetime. Together, these methods may provide a powerful means to assess the scale of migration over an extended period of time in this region.

As it has been posited that the introduction of agriculture is related to migration of people into the region, the current study hypothesises that while immigrants would be identified from outside the UMRV during all phases of occupation at the sites, this would be particularly so during the earlier phases. It is also hypothesised through analysis of the morphological traits that genetic relationships at each site could be suggested. Finally, it is also hypothesised that individuals with evidence for infectious diseases, which are otherwise rare in the region, would be immigrants.

The frequencies of the dental morphological traits at each site are calculated, and a local pattern for each site developed. The results from the morphological traits suggest low levels of migration into the UMRV, and overall group homogeneity. Despite this homogeneity, it is suggested that several individuals may have been from a different genetic pool to others at the sites, reflected in a different combination of dental traits. There is also some evidence for genetic relationships between individuals, and over time, possibly indicating familial relationships at the sites.

Stability in the Sr isotopes over time suggest a local signature for the UMRV. Sr isotopes did not support a hypothesis of large-scale immigration into the UMRV, as there were few isotopic outliers identified. Those individuals with clear outlier Sr results, and therefore probable immigrants, were predominately female. All phases of occupation of the UMRV attracted some long-range inward movement of people, although the data suggests long-range migration diminished over time.

[delta]^{13}C values show no significant change over time, possibly supporting the Sr data of limited migration into the region. While the interpretation of this isotope is primarily from a perspective of migration it is recognised that this may be limited to understanding variation in diet in the individuals.

[delta]^{18}O values show significant change over time ($p = 0.00$, ANOVA), perhaps consistent with previous research which suggested increased aridity in the UMRV. An alternative explanation of the [delta]^{18}O data is that migration increased with time, with people who were differentiated by their O isotopes but not their Sr, however, the increased aridity hypothesis is favoured here.

The hypothesis that individuals with evidence for infectious disease would be long-range immigrants into the region is rejected. None of the individuals who had physical evidence for infectious disease had chemical data to support their being immigrants.

The putative migrants to the UMRV are presented as case studies, assessing the complementarity of the methods used. It is argued that given the changes in the environment over time in the UMRV, the area may have become less attractive to immigrants and as a result the communities may have become more insular. The data yielded from the two methods have demonstrated the value of using inherited dental traits together with isotopic data of individual migration for investigating human mobility in the past. Using these methods, this study shows that there were low levels of migration into the UMRV and that long-range migration was more frequent in the earliest phases of occupation in the region.

Dudley, Neil, 2010. Field anthropology at Namu: The mortuary practices of a Polynesian Outlier. BA(Hons) dissertation, Anatomy, University of Otago.

The Namu burial ground on Taumako represents the largest burial sample in the Southwest Pacific, and is also the only Polynesian Outlier population that has been analysed. This study examines the skeletal remains excavated there to determine what mortuary practices were used, and what this reveals about the Taumako society. Analysis was carried out by examining the positions of the remains from photographs and drawings taken during excavation. The 150 individuals examined in this study were further analysed according to their age and sex, as well as their grave wealth.

In the past, archaeologists have analysed the grave goods interred with an individual to determine social information about them. However, these analyses do not portray an accurate picture of the social statuses that existed in societies. Instead they should be combined with the way the individual is treated after death, as this is more consistently associated with social rank (Carr 1995, Tainter 1978).

Field anthropology has only recently been adopted outside of French archaeology as a means for examining mortuary practices. Its methods examine the positions of the bones upon excavation. Then, by examining the composition of the site, the types of burials, burial positions, and the presence of space at the time of inhumation can all be determined. This information is then collated to determine the mortuary practice that was employed (Duday and Guillon 2006). The results were analysed statistically through Chi squared tests to look for significant differences between groups.

The full range of mortuary practices were observed in each analysis, irrespective of divisions by age, sex or grave wealth. Significant differences were observed in the mortuary practices when the ages of the individuals interred were taken into account, with each adult age group displaying a preference for one burial type. A significant result was also found for the large proportion of wealthy individuals that were young adults.

The containers used to inter individuals appear to have been made of either soft woven fabric or hard wood. The large amount of young adults who were wealthy seems to indicate that status could be inherited, but the problems of determining social status based purely on grave wealth mean that this was inconclusive. The age results seem to indicate that individuals could achieve greater status throughout their lives. Therefore it was concluded that at the time the Namu burial mount was used, an egalitarian society existed on Taumako.

Foster, Aimee, 2007. Pottery production and markers of occupational stress: Musculoskeletal stress markers and osteoarthritis in two Pacific Island skeletal samples. BA(Hons) dissertation, Anatomy, University of Otago.

The pottery of the Lapita Cultural Complex is one of the most studied aspects of this culture, yet little is known about the people behind its manufacture. This project examined markers of occupational stress in the hands of two skeletal samples, in order to determine whether it is possible to identify changes in the skeleton due to the production of pottery, and whether these differences relate to sex. A skeletal sample from the Lapita site of Teouma, Vanuatu, representing a pottery making community, was compared with another from Taumako, a non-pottery producing sample, in order to highlight any markers of occupational stress which might be related to pottery production. Fifty-three musculoskeletal stress markers (MSM) and osteoarthritis of the hand were examined, and the levels of expression of these two markers of occupational stress were compared between the samples. Overall, Teouma showed much higher MSM expression and osteoarthritis occurrence than Taumako, with strong development of muscles relating to pinch and power-grip actions. Comparison of these findings with the ethnographic record of pottery production in Southeast Asia, Papua New Guinea and the islands of Eastern Melanesia indicates these differences in the Teouma sample may be related to pottery production. MSM which demonstrated statistically significant differences between Teouma and Taumako were further compared between males and females of the Teouma sample, in order to determine whether pottery production could be attributed to a particular sex. No statistically significant differences were found between Teouma males and females for most of these markers, however, this may be due to the significant difference in body size obvious between these two groups, indicating that a greater workload for Teouma females is likely.

Little is known about other activities the Teouma and Taumako peoples engaged in. This meant that no definite conclusions could be drawn from this research regarding what the markers of occupational stress observed actually represent. However, this project has indicated that further investigation into the human side of Lapita pottery production is warranted.

Foster, Aimee, 2011. Gendered divisions of labour in Southeast Asian and Pacific Island prehistory. PhD thesis, Anatomy, University of Otago.

Within the theoretical framework of gender archaeology, this thesis aimed to provide new information about social organisation in Southeast Asian and Pacific Island prehistory. Archaeological skeletal material from five prehistoric sites in Southeast Asia and the Pacific Islands was analysed in order

to investigate the division of labour between males and females, as well as its variation in relation to environment and subsistence. This thesis represents one of only a few studies that have investigated gender and labour division in the prehistory of both regions, and fewer still have analysed skeletal remains for such a purpose.

The skeletal samples included in this thesis represent a broad range of temporal and geographic contexts within Southeast Asia and the Pacific Islands. All skeletal samples were associated with a mixed subsistence base of food production and foraging; however, the level of reliance on these resources varied between the groups.

The primary objective of this thesis was to identify differences between males and females in the expression of activity-related skeletal modifications (specifically entheseal change and osteoarthritis) that might relate to a gendered division of labour. This was achieved via direct comparison and through the use of exploratory cluster analysis. Entheses were analysed in groups representing muscles or ligaments acting on particular joints; in this way entheseal change and joint disease could be compared

in order to identify corresponding patterns of change. The results of these analyses were also clarified by the consideration of other factors (age and body size) known to influence the expression of activity-related change.

Associations observed between activity-related change, age and body size highlighted the multifactorial nature of entheseal change and osteoarthritis aetiologies; however, it was also observed that the effect of these variables was not consistent across enthesis groups or joints, or between skeletal samples. Sex was also identified as a variable that may influence the expression of activity-related change through inherent biological differences. These factors were acknowledged as caveats to the analysis of gendered divisions of labour.

Concurrent patterns of change between entheses and joints and corresponding results of direct sex comparisons and cluster analysis did, however, point to possible patterns of labour division in each sample. These patterns could be related to environment and subsistence but were also dependent on the cultural context. In the Southeast Asian samples different patterns of labour division were observed; these were linked to the relative diversity of subsistence resources and the degree to which agriculture was established.

Despite exploitation of broad subsistence bases, the Pacific Island skeletal samples demonstrated only a few differences between males and females that could be linked to gendered labour divisions. These findings were at odds with enthnographic, historical and linguistic sources, which describe distinct roles for males and females in Pacific Island societies. Alternate explanations were provided for this phenomenon. The types of activity- related change ana-

lysed might not be sufficiently sensitive to provide a detailed picture of task differentiation, so while labour levels appear to have been similar, it is possible that males and females in these skeletal samples did carry out different activities. It was also argued that distinctions between males and females inferred from other sources of evidence may not be accurate reflections of actual behaviour, and that patterns of behaviour have been subject to change over time.

Gosling, Anna, 2011. Past, present and future: Investigations into the history and possible causes of genetic predisposition to metabolic diseases in Pacific populations. MSc thesis, Anatomy, University of Otago.

Many indigenous Pacific populations have been observed to have a high prevalence of Type 2 diabetes and gout. While lifestyle factors are likely to contribute, there is evidence to suggest that there is a hereditary contribution to these diseases. A number of genetic loci which confer risk have been identified – notably, polymorphisms in the genes SLC2A9 (rs16890979, rs5028843 and rs11942223) and ABCG2 (rs2231143) have been found to have statistically significant associations with gout in Pacific Island and Māori populations in New Zealand.

Gout has been found to leave a bony signature in sufferers of the disease. Such lesions have been found in archaeological human remains from a number of Pacific Islands. The development of ancient DNA technologies provides a unique opportunity to explore the antiquity of genetic variants which have been found to contribute to gout in modern populations. Thus, this thesis aims to explore the feasibility of using ancient DNA to investigate genetic diseases in the past, and whether it can be used to determine the presence of polymorphisms predisposing to gout in these past populations. Samples excavated from archaeological sites at Wairau Bar, New Zealand, and Atafu, Tokelau, were used for this task.

Consideration of human history in the Pacific, especially past population movements and entanglements, as well as selective pressures such as the introduction of diseases and adverse environmental conditions, contribute to understanding how these genetic variants may have become conflated in Pacific populations.

Halcrow, Siân Ellen, 2006. Subadult health and disease in late prehistoric mainland Southeast Asia. PhD thesis, Anatomy, University of Otago.

There is a general belief that a decline in health of prehistoric people occurred with the adoption and intensification of agriculture. However, recent bioarchaeological research in Southeast Asia does not seem to fit this model. An investigation of subadult health is particularly useful to assess this issue

because immature individuals are very responsive to environmental changes. The increase of archaeological investigation in this region has provided an adequate sample to address this important aspect of human health using subadults. The aim of this thesis was to produce a synthesis of subadult health and disease from late prehistoric mainland Southeast Asia and assess whether there was evidence for a change in health with agricultural intensification. The samples, comprising a total of 325 individuals, are from seven sites in Thailand, six from the northeast and one from the southeast coast, and collectively span from c. 4000 to 1500 B.P. Two hypotheses were developed based on previous bioarchaeological research in Southeast Asia. Firstly, there would be maintenance in health with the intensification of agriculture. Secondly, contrary to the first hypothesis, an increase in infectious disease in the later samples was predicted.

A biocultural research approach was used, where health and disease were assessed in relation to evidence of the natural and cultural milieu. A comparative analysis of health indicators was carried out among the sites to assess whether there were any changes in health over time in response to environmental changes. Non-specific indicators of health were used in the assessment of palaeodemography, growth, growth disruption, dental health and skeletal pathology.

Analysis of mortality, fertility, growth, growth disruption and dental health found no differences among the sites that could be explained by temporality. These results support the first hypothesis, that health was maintained. The skeletal pathology results tentatively suggested an increase in these indicators in the later sites. An analysis of multiple indicators of stress in the populations indicated a possible decline in health, interpreted with environmental evidence suggesting an increase of infectious disease at the later sites. However, they suggest that the earliest site of Khok Phanom Di had extremely poor health. Thus, the second hypothesis was only partially supported.

Environmental evidence was used to provide possible explanations for these results. The heterogeneity of the health indicators support recent interpretations of localised environments of the sites. Also, retention of a broad-spectrum subsistence economy with agriculture may have overridden some of these changes that were seen in other parts of the world. Khok Phanom Di and the later sites were undergoing major changes in their natural and cultural environment, which could have resulted in an increase of infectious disease. These health results are consistent with suggestions that Khok Phanom Di was a distinct genetic population from those at the northeast Thai sites. This biocultural interpretation emphasises the importance of understanding the environmental context in which these people lived.

Harris, Nathaniel John, 2010. Disposing of the dead: An investigation into prehistoric mortuary practices during the Neolithic and Bronze Ages at Ban Non Wat, Thailand. MSc thesis, Anatomy, University of Otago.

Ban Non Wat is a prehistoric mounded site located in the upper Mun Valley of northeast Thailand. It was excavated over five years under the Origins of the Civilisation of Angkor research project, which uncovered 635 human burials ranging from pre-agriculturalists to Late Iron Age inhabitants. This thesis examined 244 adult burials in nine mortuary phases from the Neolithic and Bronze Age, applying an *anthropologie de terrain* approach. The main aim of the thesis was to examine the mortuary practices used in each mortuary phase and compare these practices over time.

Anthropologie de terrain is a taphonomically based methodology used to reconstruct past funerary practices. Upon careful examination of skeletal elements within a grave it is possible to determine whether a burial was primary in nature or occurred over multiple episodes (burial type), the original position of the cadaver within the grave (burial position) and what kind of container an individual was interred in (burial context). An anthropologie de terrain approach was adapted to allow the analysis of a large number of burials based on photographs and field drawings. Iron Age burials were excluded from the research because of their often disturbed and fragmentary appearance.

Two hypotheses were put forth: that mortuary practices would change over time as social, technological, and susbsistence practices became more complex; and that mortuary practices would be linked to social identity. The aspects of social identity examined were sex, age, wealth and the location of the burial, as it has been suggested by Higham (pers comm.) that the grouping of individuals at the site may represent family clusters. By examining links between mortuary practices and social identity it was possible to assess the suitability of the mortuary practices examined as indicators of different modes of social organisation.

An increase was found in the variety of mortuary practices used over time, especially burial context, which showed the most variety at the end of the Bronze Age. This differed slightly from findings at the nearby site of Ban Lum Khao (Willis and Tayles 2009), where Late Bronze Age individuals were interred in one context.

Links between mortuary practices and social identity were not found for the Neolithic or Bronze eras. The practice most likely to show conclusive results was burial context, which had relatively large sample sizes. However, no correlations were found between burial context and any aspect of social identity investigated, suggesting two possible interpretations. Firstly, burial context is not a reliable indicator of social status, as there were no demonstrable links

between context and wealth. Secondly, an unidentified variable other than sex, age, location or wealth influenced the choice of container. It was proposed that this variable was the season of death, with busy periods coinciding with the rice harvest necessitating less elaborate and time consuming burial practices.

Kinaston, Rebecca, 2010. Prehistoric diet and health in the western Pacific Islands. PhD thesis, Anatomy, University of Otago.

The mode of subsistence of the earliest populations that colonised Remote Oceania, the people associated with the Lapita Cultural Complex, remains a contentious issue and, for many Pacific islands, the extent to which chronologically later prehistoric populations relied upon horticultural products is unknown. The overarching aim of this thesis is to assess the diet and subsistence of six prehistoric Pacific Island skeletal samples to understand the possible health implications of these dietary patterns. This research is the first study focused on analysing variations in diet between the sexes and between age cohorts within prehistoric Pacific Island skeletal samples to assess the possible health implications of potentially culturally moderated food-related practices.

The materials used in this study span 3000 years of Pacific Island prehistory and include four Lapita-associated skeletal samples from Vanuatu (Teouma [n=49], Uripiv [n=5] and Vao [n=4]) and Papua New Guinea (Watom [n=4]) and two skeletal samples that date much later in prehistory (600-400 BP) from Papua New Guinea (Nebira [n=31]) and the Solomon Islands (Taumako [n=158]).

The objectives of this study were to characterise the diet of these six skeletal samples by analysing carbon, nitrogen and sulphur stable isotopes of bone and tooth collagen (the distal root portion of the first molar root, formed from ages 5-9) in conjunction with tooth wear and oral health indicators (caries, calculus, periapical cavities, periodontal disease and antemortem tooth loss) to assess if these methods were comparative or complementary for reconstructing past diet. The second objective used the prevalence of linear enamel hypoplasia (LEH) as a non-specific indicator of stress to assess the health of the skeletal samples. The third objective was to compare the dietary and health profiles of the adults and subadults to assess whether there were differences between survivors and non-survivors. Lastly, evidence of LEH was compared between the cemetery samples to investigate whether the possible diachronic dietary transitions were associated with a decline in health.

The dietary results indicated that there were temporal variations in diet and subsistence; the chronologically earliest sample, Teouma, practised a broad-spectrum hunting/gathering and marine foraging subsistence and, at

the other sites, there was an increase on the reliance of horticultural products over time. The exception to this trend was the skeletal sample from Taumako, which had dietary evidence of a heavy reliance on marine products. Sexual differences in the protein portion of the diet only occurred at Teouma, the chronologically earliest site. The LEH results indicated there was a decline in health over time. At Taumako there were dietary and health differences between the survivors and non-survivors; the non-survivors were consuming less protein and had more evidence of stress than the survivors. At a number of sites, the stable isotope values of tooth collagen indicated that, as children, the adult individuals had consumed more protein from higher trophic levels than as adults.

From this data it is suggested that the stable isotope analysis may have over-represented the high protein marine portion of the diet, although it did show evidence of dietary change over time. The dental evidence assisted in the stable isotope analysis of diet, but the consumption of betel nut may have affected the oral health in a number of skeletal samples and therefore could influence the effectiveness of using oral health as a dietary indicator in the Pacific Islands. The dietary differences between the sexes observed in the earliest populations may have been a result of 'ranked' social structure of Lapita-associated populations. The later populations may have had culturally-induced dietary differences between males and females but these may have centred around foods that could not be identified by the current analyses because they were of a similar food type, but prepared in a 'special' manner, such as a pudding, making any differences invisible isotopically. The analysis of childhood diets (of the adults who survived) did not follow the dietary patterns observed in modern-day Pacific Islands, which document a lower protein diet of children compared to adults. However, the diet of the non-survivors did agree with modern accounts, and this type of diet may have contributed to their early death. The health assessments indicated that there was an increase in stress as populations became more reliant on horticulture, although it is inconclusive as to whether or not this was a result of a decrease in nutritional quality and/or a response to the higher prevalence of infectious disease associated with larger population sizes and increased sedentism.

King, Charlotte L., 2009. "For dust you are and to dust you shall return": The chemical evaluation of diagenesis in the burials of Ban Non Wat, Thailand. BSc(Hons) dissertation, Anatomy, University of Otago.

The excavation of Ban Non Wat, Thailand, has unearthed over 600 skeletons, of varying completeness. This large sample size has allowed bioarchaeological study of the individuals represented in a number of ways, includ-

ing demographic studies, analysis of pathology and isotope studies. The use of strontium isotopes in tooth enamel to trace migration of the population has been successful, but dietary isotopic work is not possible due to remineralisation of bone, and associated loss of collagen. This study aimed to fully describe the diagenesis of the bone at Ban Non Wat using bone samples from Bronze Age burials. The extent of diagenesis was evaluated using both FTIR and Raman spectroscopy. Quantification of elemental substitution into the bone structure was investigated using LA-ICP mass spectrometry. The results of the study reveal diagenesis is most dependent on soil composition and groundwater flow, through bone porosity and burial treatment also have effects.

Labidon, Sigrid Lorraine S., 2010. Degenerative joint disease in a human skeletal sample from prehistoric Tonga. PGDipArts dissertation, Anatomy, University of Otago.

Degenerative joint disease, characterised as a disorder of the joints resulting in the deterioration of the articular cartilage and the formation of adjacent bone, in a skeletal sample from prehistoric Tonga is examined and analyzed. This study investigates the activity patterns of these prehistoric people by looking at the prevalence and distribution patterns of DJD in each individual in the sample. The prevalence and distribution patterns, along with archaeological and ethnographic accounts of prehistoric life on the island, were used in inferring activity patterns of people during the prehistoric past.

Three criteria for the diagnosis of degenerative joint disease were observed: eburnation, macroporosities and osteophyte formation. These bony changes were examined and their prevalence and extent recorded. The distribution patterns of DJD in each joint were then analyzed and compared to other joints within the sample. The overall distribution was also compared to other samples in the Pacific. It was hypothesised that there will be a difference in the distribution pattern according to age and sex.

It was found that the prevalence of DJD in the Tongan sample was low, with the cervical region of the vertebral column being the most affected. There was no difference in the distribution pattern of DJD according to sex, which does not reflect the sexual differences in labour recorded ethnographically. However, there was a marked difference, though statistically insignificant, in the distribution pattern according to age. DJD was found to be more prevalent among older adults than young adults.

The prevalence of DJD in Tonga, as with the other samples from the Pacific that were reviewed, were quite low. Moreover, the distribution patters of DJD in Tonga matched the samples from areas with recorded social stratification and monumental architecture. The low prevalence of DJD in Tonga,

as well as the other samples from the Pacific, can be attributable to a genetic predisposition of Pacific people to resist the development of DJD, as recent clinical studies of Pacific Islanders living in the United States has revealed that Pacific Islanders were the least likely to report pain due to arthritis compared to Caucasians, Hispanics and Asians. Their generally larger body size, combined with a typically active lifestyle, could have helped provide a buffer against the development of DJD. However, further studies on the relationship between activity, genetics and DJD need to be accomplished in order to ascertain the effects of genetics and activity patterns in the development of DJD.

Mann, Sarah, 2007. The people of Taumako: The health and wealth of a Polynesian Outlier. BA(Hons) dissertation, Anatomy, University of Otago.

This research utilises skeletal material and grave goods from Taumako, to examine whether social status can be inferred from these materials. Analysis of wealth was conducted on both jewellery pieces and single artefact units. Health of the 222 individuals from the Taumako burial mound was assessed through the age, and sex of each individual, as well as the presence of linear enamel hypoplasia (LEH) and treponemal pertenue.

Health and wealth of each individual was used to assess an individual's social status. This is based on the suggestion that an individual's social status in life will be reflected in death through the graves offerings their community presents to them at their time of death (Wason 1994).

The methods used to conduct the analysis of wealth for each individual were the 'presence method' (O'Reilly 1999) and the 'rarity method' (Hodson 1977). The relationship between health and wealth was measured by comparing the data groups using the one-way anova test and t-test.

There was a significant difference among the age groups in relation to the quantity and quality of the grave goods, with old aged adults having a greater number of individuals with grave offerings. Females had more grave offerings and rare offerings than the male individuals.

It was also concluded that all individuals went through a period of stress during childhood, as reflected by the correlation with LEH, regardless of their social standing in the community. Individuals with yaws were treated differently at Taumako, this is seen by the low number of grave offerings presented to the 14 individuals who show the skeletal evidence of yaws.

McLeod, Nicola, 2010. Pathological conditions in a cluster of burials at the site of Ban Non Wat, northeast Thailand. BA(Hons) dissertation, Anatomy, University of Otago.

Ban Non Wat is a prehistoric site in the Mun River Valley on the Khorat Plateau in northeast Thailand. This site was excavated over seven seasons from 2002-2007 and over 600 human skeletons were uncovered. There has been no in-depth pathological study done on the human remains. The aim of this dissertation is to create differential diagnoses of pathological conditions in a cluster of six skeletons from the second Bronze Age mortuary phase.

Age and sex estimates were completed for each individual following the standards set out in Buikstra and Ubelaker (1994). Each bone present in all skeletons was studied macroscopically for signs of pathological change. These changes were recorded, photographed and in some instances x-rayed. All possible causes for the lesions were considered as part of the differential diagnoses and the most probable causes were determined.

All six individuals showed evidence of joint degeneration and change attributable to probable osteoarthritis and vertebral spondylosis. This is unsurprising as joint degeneration is ubiquitous in all societies. Five individuals show evidence of probable trauma which is also unsurprising for individuals leading physically active lives. One of the males with the most severe traumatic change has probable bilateral comminuted humeral head fractures with shortening of both limbs and possible necrotic change. Two other males and two females had breaks to the small bones of the hands feet and clavicles.

Another ubiquitous finding is dental disease. All six individuals show wearing of the occlusal surface of the dentition and all individuals have dental caries of varying number and size. Three individuals have evidence of horizontal resorption of the alveolar bone indicating periodontal disease. One male and one female also have periapical inflammations in the maxillary alveolar bones. One male and two females have horizontal banding on the anterior surface of the incisors and canines, suggesting linear enamel hypoplasia. This is caused by a pathological condition in childhood such as malnutrition or illness.

None of the skeletons have evidence of systemic infections but two females have interesting osteoclastic lesions on the inner parietal bones. A possible diagnosis for these changes is a neuroblastoma or a similar tumour.

One male and one female have probable Schmorl's nodes on the lumbar and thoracic bodies. This condition may have a genetic predisposition which may mean that these two individuals could be related. The pathology may also have arisen independently in each individual through similar working conditions.

Trauma, joint degeneration and dental diseases are all ubiquitous in societies so it is not surprising to see these in the cluster.

Robb, Kasey, 2008. Adaptation to the Pacific Island environment. An investigation of non-specific indicators of stress in prehistoric human skeletal remains. MSc thesis, Anatomy, University of Otago.

Goodman et al. (1988) explain that stress focuses on the cost and limits of adaptation. This study investigated non-specific indicators of stress in human skeletal remains from seven prehistoric sites in the Pacific Islands as an attempt to gauge the success or failure of adaptation to an island environment. The samples used in this study represent both colonising and established populations and are spread geographically throughout the Pacific Islands. The Pacific island environment varies in the distribution of biota, including important nutritional sources and vectors for disease transmission (particularly malaria) that all have implications for the adaptability of prehistoric populations to their island environment. The study of cortical thickness in Pacific island samples has not previously been included with the investigation of other non-specific indicators of stress and therefore allows comparisons of patterns of appositional growth both between and within populations. In the current study both inter- and intra-sample comparisons of cortical thickness, maximum femoral length and linear enamel hypoplasia were made to assess if there were any differences in patterns of growth disruption in subadults (n=17) and adults (n=100). No significant correlations were determined between the nonspecific indicators of stress and the temporal and spatial distributions of the samples. This is because there was very little variation in results between samples. Within all the samples there was evidence of an age-related decline in cortical thickness and sexual dimorphism of cortical thickness and maximum femoral length. There was no evidence that incidences of childhood stress affect the adult attainment of their genetic potential for growth. Subadult measures of cortical thickness in neonates showed increased values when compared to modern reference standards but the adult means clustered around the minimum recommended cortical thickness for modern healthy populations. These results suggest a difference between prehistoric and modern growth patterns but show no evidence for chronic ill health. Overall, the indicators used in the current study showed very similar results and therefore do not reflect evidence for differential adaptation to the Pacific island environment through time and across the island groups. This could have been the result of small sample sizes or the limitations of bioarchaeological studies and needs to be further investigated with the use of other non-specific indicators of stress and evidence of disease in Pacific island samples.

Scott, Rachel Manu, 2008. Skeletal trauma in prehistoric Oceania: A biocultural study using samples from Papua New Guinea, Solomon Islands, Vanuatu, Tonga and New Zealand. MSc thesis, Anatomy, University of Otago.

Until recently, the study of trauma in prehistory has been limited to individual case studies. Applying a broader anthropological approach to the analysis of traumatic lesions found in archaeological samples can highlight the environmental and cultural factors that may have influenced trauma in the past. The aim of this study was to record the types and prevalence of adult skeletal trauma in pre-contact Pacific Island samples using a biocultural approach in an attempt to understand variation in the stressors causing trauma. Adult skeletal remains from Nebira, Papua New Guinea (AD 1230-AD 1560), Taumako, the Solomon Islands (AD 1530-AD 1698), Teouma, Vanuatu (1000 BC-500 BC), Tongatapu, Tonga (AD 1100-AD 1250), and Palliser Bay, New Zealand (AD 1261-AD 1480) were macroscopically examined for evidence of cranial trauma, postcranial fractures, dislocations, ossificans exostoses and piercing or perforating wounds to assess the relationship the inhabitants had with their environment, with each other, and to identify how different groups in the Pacific were affected by the ecological boundaries and social systems they lived in. Three hypotheses were tested. First, that frequencies and patterns of skeletal trauma would differ between coastal and inland samples. Hypothesis 1(A) stated that the island environments of Teouma and Taumako would produce similar patterns of trauma. This hypothesis was proven as the samples exhibited a similar prevalence of trauma. The distribution of the injuries at Teouma suggested a balanced sexual division of labour, possibly while establishing a new settlement on the island. Cranial trauma in the Taumako sample indicated some level of non-lethal interpersonal violence between men and women while piercing trauma in the sample suggested the inhabitants actively participated in warfare, perhaps compounded by environmental pressure and resource stress. Hypothesis 1(B) stated that the inland sample from Nebira would exhibit a higher prevalence of accidental injuries compared with the coastal sites. The inhabitants from Nebira did not exhibit higher numbers of accidental injuries but instead showed a high prevalence of cranial trauma (21.42%), indicative of interpersonal violence. One explanation for this may be that the inhabitants were encouraged by climate change to compete for resources, causing disputes between groups. Hypothesis 2 stated the founder populations of Teouma and Palliser Bay would exhibit a higher prevalence of accidental injuries because of their unfamiliarity with the terrain and the extra physical pressures placed on them to construct a community and establish agriculture. The sample from Palliser Bay, while small (n=8), has individuals who have experienced accidental

injuries suggesting that, like Teouma, the foundation of a new settlement in unfamiliar geography was difficult, supporting the hypothesis. Hypothesis 3 stated the inhabitants from Tongatapu, who lived during a tumultuous period, would exhibit a high prevalence of traumatic injuries from interpersonal violence or warfare. This hypothesis was not conclusively proven. The sample consisted of forearm fractures indicative of defense fractures. However, the lack of cranial trauma in the sample contradicted the hypothesis. A tentative explanation for this is that the people of Tongatapu practiced non-lethal ritualised violence as a way of dispute resolution in the form or boxing or wrestling. The results illustrate that the physical surroundings of the Pacific Islands in prehistory influenced the risk of injury in the past. Injuries occurred accidentally while practicing occupational or subsistence strategies, and intentionally because of social pressures that could have been influenced by many factors, including climate change and resource stress.

Shaw, Ben, 2007. The potential use of strontium isotopes as an indicator of mobility in Lapita populations in the Pacific Islands: Problems and solutions. BA(Hons) dissertation, Anatomy, University of Otago.

Strontium isotopes have been used in recent years successfully as a provenance indicator in prehistoric populations, being mainly applied in Europe and South America. Methodology has been developed to systematically identify mobility in these populations using tooth and bone samples that represent the first 14 years and last 10 years of life respectively.

The application of strontium using human skeletal remains follows the assumption that the strontium (87Sr/86Sr) in bone and teeth reflects the collective uptake of water, plant and meat foods from the geological area in the vicinity of the site. In continental landmasses there is a marked differentiation of strontium values between geological regions, this geological variation is the underlying principle in identifying individuals from different geological regions.

In the Pacific Islands, the andesite line marks the junction between continental islands to the west and oceanic islands to the east. Oceanic islands form as volcanic activity uplifts magma through the Pacific plate, creating a new island. As the plate moves so does the island mass, with the creation of other islands from the same magma plume creating a time-progressive island chain typically running southwest-northeast. It has been suggested that coastal and island environments do not show enough strontium variation to infer mobility using this methodology and as the majority of Pacific Islands are made up of volcanic basalts from these magma 'hotspots' it is then assumed that strontium isotope analysis will not work in this environment.

This paper investigates the potential application of strontium isotope analysis on the Lapita Cultural Complex, an Austronesian-speaking group of archaeologically-defined people that developed in the Bismarck Archipelago and were the initial colonists of Remote Oceania. The rapidity of this migration event dating to 3300-2500 BP should hypothetically be visible in the strontium uptake in the skeletal remains of these people as they moved through the islands during their lifetime. As a preliminary investigation into the effectiveness and accuracy of strontium in identifying mobility in Lapita people, a pilot study using 10 teeth from two Lapita age sites in the Anir (Feni) Islands off the south-east coast of New Ireland in the Bismarck Archipelago. The sites of Kamgot and Balbalankin represent Early (3300-3000 BP) and Middle (2900-2700 BP) Lapita periods respectively. The aims of this project are fourfold:

- establish a strontium signature for these sites using human and pig tooth samples
- investigate the potential effect post-mortem contamination may have had on these samples
- identify any outlying of 'non-local' individuals
- identify, discuss and counter the major problems inherent in using strontium isotope analysis in the Pacific Islands.

Shaw, Ben, 2009. Prehistoric migration in Melanesia: Evidence from isotope, trace element and non-metric dental trait analyses. MSc thesis, Anatomy, University of Otago.

Migration is a widely used explanation for culture change in the archaeological record. In the southwest Pacific Islands, migration was essential for the colonisation of the island groups in Near and Remote Oceania during the Lapita Cultural Complex (~3300-2200 BP). Lapita is an archaeologically recognised cultural group defined by the presence of a distinctively decorated ceramic tradition.

This thesis seeks to directly assess prehistoric migration and mobility in New Guinea and the Bismark Archipelago using isotope (87Sr/86SR and δ18O), trace element (Ba/Sr) and non-metric dental trait analysis. Samples included in the analysis were from Lapita human (Reber-Rakival and Lifafaesing) and pig (Reber-Rakival) samples in the Bismarck Archipelago as well as from a post-Lapita human population on the New Guinea mainland (Nebira). Isotopes and trace elements were measured in the tooth enamel of individuals because enamel develops during childhood and provides a retrospective record of where the individual lived while the tooth was developing. Therefore a shift in location during adulthood can be inferred. On the other hand, non-metric dental traits are known to be genetically controlled and inherited. Assessing

these traits in prehistoric populations may therefore allow individuals to be identified that have migrated from genetically distinct populations.

The isotope and trace element data from the human individuals from Reber-Rakival suggests that one young female may have been a migrant to the site. Also, several pigs were possibly transported to the island from four potentially separate locations. No migrant individuals were identified at Lifafaesing. The isotope and trace element data from the Nebira individuals suggest there may have been nine migrants to the site from four potentially separate locations. A group of five non-local individuals at Nebira potentially migrated from a coastal location.

The non-metric dental traits were only recorded in the individuals from Reber-Rakival and Nebira as those teeth were from intentional inhumations. The non-metric dental traits exhibited a similar pattern of trait frequency within both populations. While some patterns of these traits showed differences between the local and non-local groups identified through isotope analysis, there were no statistically significant differences in trait frequencies between the groups.

The variation in the isotope and trace element data measured in the tooth enamel of the individuals within and between the sampled sites indicates there is enough variability to identify prehistoric migration and mobility in a Pacific Island context, with a clear distinction between island and inland populations identified. The similarity in non-metric dental trait frequencies in the individuals from Reber-Rakival and Nebira may reflect interaction and migration between genetically similar communities, but was not as powerful for identifying migration as the isotopic data.

Trilford, Danielle M., 2010. Oral health as a reflection of diet in Archaic Palliser Bay, New Zealand. BA(Hons) dissertation, Anatomy, University of Otago.

Ongoing archaeological research of the people that make up our past communities gives great insight to our present human condition. New Zealand's pre-contact people are arguably the most studied element of archaeology in New Zealand. While such research makes groundbreaking gains on the study, there are still aspects of the archaeological discipline that cannot yet suggest the existence of direct evidence showing how such peoples survived.

This dissertation aims to comprehend what these people were eating, by evaluating the oral health of ten kōiwi tangata (human skeletal remains) from Palliser Bay, a New Zealand Archaic site, found on the south coast of New Zealand's North Island. The bioanthropological approach to evaluating this aspect of these peoples' lives gives firm and direct evidence about what

they were eating, also providing an alternative perspective to archeologically-derived conclusions on diet in pre-contact New Zealand. This site-specific analysis on oral health will use only the most recent methods of exploring the macroscopic evidence of diet in occlusal wear, caries, calculus, periodontal disease, antemortem tooth loss and periapical inflammation and infection, to not only accompany archaeological evidence, but also the re-evaluation of skeletal and dental health from Wairau Bar – another New Zealand Archaic site (Buckley et al. 2010).

Key findings include extremely high levels and frequencies of occlusal wear suggestive of an extremely gritty diet, periapical infection suggesting periods of malnutrition and weak immune systems, high levels of periodontal disease, and other indirect evidence for high rates of calculus. Meat and carbohydrate consumption rates appear different to what is currently proposed by Helen and Foss Leach, who studied this site in 1979. Seasonal food consumption, and a gritty fibrous diet, on the other hand, has been further grounded by the findings of periapical abscessing and high levels of occlusal wear respectively. The findings of this study, when combined with the archaeological evidence of this coastal valley site, compliment and confirm existing understandings of diet in Archaic central New Zealand, whilst challenging for a reconsideration of others. Overall, the oral health analysis of an Archaic New Zealand site has exposed not only what people were eating, but also just how valuable the bioanthropological approach can be to understanding their lifestyle. These results, divergent from the current understanding or not, are indicative to great strides made in the archaeological discipline, all of which can reveal the ways in which our pre-contact ancestors lived.

Ward, Stacey, 2009. Lead and copper at prehistoric Ban Non Wat: Helpful or harmful? BA(Hons) dissertation, Anatomy, University of Otago.

Lead and copper, two constituents of bronze, are harmful to human health in large quantities. This study aimed to see if metalworking and the use of bronze at the prehistoric site of Ban Non Wat, northeast Thailand, was harmful to the health of the putative metalworker, Burial 549 and his peers.

Flame atomic absorption spectrometry was used on 16 soil samples and 11 bone samples from the Iron Age 1, Bronze Age 4 and Bronze Age 2 mortuary phases, to determine if lead and copper was present in abnormal quantities. Soil lead was normal, but four of 16 soil samples were above the normal range for Ban Non Wat. However, none of the lead or copper soil samples were near toxicity level. Bone lead was abnormally low and lead or copper soil samples were near toxicity level. Bone lead was abnormally low and copper abnormally high. Since the health of the Ban Non Wat population is assumed to be good, it

is not likely these soil and bone metal concentrations were harmful to human health.

Other research objectives were considered. It is possible that copper and lead are present at Ban Non Wat due to a combination of natural deposition, and leaching from human-made hearths and metal artefacts. Their presence in the soil may have altered the bones used in this study in a process called diagenesis. It was found that metal concentrations changed over space and time and that there were slight correlations between heavy metals and the age and sex of burials, with older women having more copper and men more lead in their bones. It has been proposed that these age and sex differences are caused by dietary variation and sex-specific phenomena such as menopause. Burial 549 showed osteophytes and joint deterioration in his knee and elbow, which is consistent with pathology shown by metal workers on Non Pa Wai (Agelarakis 1996). This, along with his higher bone metal concentrations, supports the suggestion that Burial 549 was a metalworker.

Ward, Stacey, 2011. Burning issues: An investigation into the cremation practices used in the historic Lan Xang Period of the Lao People's Democratic Republic. MSc thesis, Anatomy, University of Otago.

Bone fragments remaining after cremation can be used to provide information on the cremation practices of ancient cultures. This is possible as the study of bone colours can indicate what type of fire was used for the cremation and the position of the deceased during the cremation procedure (Symes et al. 2008). The type and depth of heat fractures are linked to the amount of flesh remaining on a body at the time of cremation, and therefore can reveal how long after death the cremation occurred (Whyte 2001).

In this way, cremation practices have been examined globally, but there is a dearth of information on past cremation methods in Southeast Asia. With the discovery of archaeological human remains in Vientiane in the Lao People's Democratic Republic in 2006-2007, an opportunity arose to investigate the cremation practices used in the Lan Xang period of Lao history (1353– c. 1695 CE) (Evans 2002). The human remains, constituting a total of 25 people, consisted of individuals that had been cremated and interred in jars, cremated and scattered, or buried without cremation. While this was a small sample, it provided a rare opportunity to contribute to the limited knowledge on cremation practices in the Lan Xang Kingdom.

This thesis aimed to contribute to the clarification of the cremation process used during the Lan Xang period, to identify variations within this process based on age, sex, pathology, burial weight, burial goods, burial jars

and geographic location, and to clarify the issue of the archaeological dating of the inhumation burial BHB01.

Results showed that Lan Xang people were often cremated after their bodies had decomposed for a short time. Patterns of which skeletal elements were represented suggested individuals were cremated in a supine position, and cremation temperatures, which ranged from 485-940°C, were consistent with cremation on a wooden pyre. Skeletal temperature patterns suggested the pyre was ignited around its edges.

Small sample size and poor representation of the remains made the identification of variation within the sample difficult. However, it appeared that age and type of death, as indicated by skeletal pathology, were most likely to have caused the variations observed in the Vientiane sample. Age was the main variation because Lan Xang children were cremated when modern children are not. It is also possible that pathology, and therefore the type of death, explains why some cremation burials included burial items or were buried in different jar types to their contemporaries.

Analysis of the inhumation burial BHB01's burial position, burial goods and burial depth suggested an archaeological date of the Iron Age (420 BCE-500 CE) (Higham and Higham 2009), but radiocarbon dating was suggested in order to clarify this issue.

It was concluded that Lan Xang cremation practices were similar to modern Thai practices, but were influenced by age at death and type of death. Despite the inherent flaws identified in the methodology used for analysing cremation burials, this thesis shows that cremation burials can nevertheless provide valuable information about a culture.