



ABSTRACTS

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The abstracts are printed in alphabetical order of authors.

***Homo floresiensis*: Microcephalic, pygmoid, Australopithecus or Homo?**

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The remarkable partial adult skeleton (LB1) excavated from Liang Bua cave on the island of Flores, Indonesia, has been attributed to a new species, *H. floresiensis*, based upon a unique mosaic of primitive and derived features compared to any other hominin. The announcement precipitated widespread interest and attention quickly focused upon its possible affinities. It is described as a small-bodied hominin with an endocranial volume of 380 cm³ or 410³ and stature of one metre, and is dated to 18,000 and 34,000 years ago. *H. floresiensis* was originally proposed to be the end product of a long period of isolation of *H. erectus* or early *Homo* on a small island, a process known as insular dwarfism but this hypothesis was revised after further material was found. It is now proposed to have closer affinities to *Australopithecus*, as the postcranial material is considered to most closely resemble this species. Other interpretations have been proffered: that it is a human afflicted with the condition of microcephaly; that it is a human pygmy.

To explore the affinities of LB1, cranial metric analyses are undertaken. LB1 is compared to early *Homo*, two microcephalic humans, a ‘pygmoid’ excavated from another cave on Flores; *H. sapiens*, including Andaman Islanders; *Australopithecines* and *Paranthropus*. Results would indicate that it is unlikely that LB1 is a

microcephalic or pygmoid human or that it derived from *H. erectus*. Rather, its affinities lie with earlier *Homo*; it does not appear to be attributable to any of the known species and the attribution of a new species, *H. floresiensis*, is supported.

Roonka and the transition from Australoid to Australian craniometrics

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One way to characterise craniometric patterns in a population is to classify a sample of individual specimens with respect to reference populations. This study employs Ousley and Jantz's Fordisc 2.0 computer program to classify Australian crania with reference to the populations measured by W.W. Howells (excluding any Australian specimens whose available measurements do not allow at least 50% of the Howells specimens to be correctly classified). The terminal Pleistocene crania are "Australoid", rather than Australian, because many more of them are classified as Tasmanian or New Britain (Tolai) than as Australian. In contrast, fully one half of a large sample of recent Aboriginal crania from across Australia is classified as Australian, and only one quarter as Tasmanian or Tolai. The Roonka crania suggest that the Australian craniometric pattern was established soon after the drowning of the Pleistocene land bridges that had connected Australia to Tasmania and New Guinea. Whether we consider the early Holocene, middle Holocene, late Holocene, or undated crania from Roonka, approximately half are classified as Australian, and a quarter or less as Tasmanian or Tolai. Interestingly, where we can detect retention of the Pleistocene pattern is the classification of a substantial minority as long-headed "Mongoloids" (Guam Chamorros, Easter Islanders, Eskimos). This is a feature of the Coobool Creek skulls, Lake Nitchie, and the early to middle Holocene Roonka crania, but very rarely occurs with recent Australian crania.

The author gratefully thanks Professor Tsunehiko Hanihara of Saga Medical School, Japan, for assisting him with his unpublished craniometric data.

Demography from an archaeological skeletal sample: Roonka Flat, Lower River Murray, SA, 10,000 BP–100 BP

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Demography of past populations is confounded by, amongst other factors, cultural bias in burial and subsequently, age-specific preservation which often results in under-representation of children, especially infants. However, good preservation combined with careful excavation by Graeme Pretty of the site of Roonka Flat, Lower River Murray, SA, has provided a skeletal sample which contains a large proportion of child skeletons. This suggests that burial and preservation biases are unlikely at this site and that the sample is thus suitable for demographic analysis.

Lifetable analysis of this sample ($N = 139$) was performed using palaeodemographic techniques. This analysis revealed a population with moderate mortality (new born life expectancy 25.6 years, survivorship to 15 years 66.96%). The fertility rate was low (6.06) in comparison with other hunter-gatherer populations, but is consistent with ethnographic accounts of Australia at first European contact. The Biological State Index (0.43) indicates the population was able to reproduce itself with ease and was thus a successful, growing population subsisting upon the rich riverine resources.

Living the fly-in/fly-out life: The lifestyle and health of Australian fly-in/fly-out mining employees and their partners

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Approximately half of all Western Australian mining industry employees work on a fly-in/fly-out (FIFO) working schedule, requiring the workers to frequently leave their personal accommodation in large cities or towns and reside in remote workplace camps for the duration of their working roster. The need to frequently alternate between living in personal and workplace environments can be a major source of disruption and psychological stress, and has the potential to negatively impact on the lifestyle, health behaviours and health outcomes of employees and their partners.

This paper will review the available empirical and anecdotal evidence describing the effects of FIFO on Australian employees and their partners. Preliminary research suggests that Australian employees and partners find FIFO to be disruptive to their social, family and domestic lives, and to exacerbate weaknesses in relationships. However, as FIFO has only recently become widely used in WA and there are few studies in the area, there is a need for further research to expand on these findings.

A project consisting of a cross-sectional questionnaire study and a longitudinal health measures study is currently being conducted to explore the effects of FIFO on lifestyle and mental and physiological health, and to investigate whether social support buffers against the negative effects of FIFO. As FIFO is expected to continue to be commonly used in the Australian mining industry, this project aims to assist employees, partners and employers to minimise FIFO – related difficulties, and thereby improve the health and wellbeing of employees and their partners.

Using ancient DNA to analyse environmental and evolutionary change

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The most difficult aspect of ancient DNA research is the issue of contamination with modern DNA, and whether results can be reliably demonstrated to be authentic. This problem is extreme in the case of ancient human specimens because most archaeological specimens are deeply contaminated with DNA from archaeologists, museum curators, etc. In such cases it is often impossible to prove that any recovered DNA is really authentic, even when it appears to originate from the sample. Furthermore, DNA damage appears to mimic evolutionary change and can lead to apparently consistent, but erroneous, results.

AMS carbon-dated bones of Pleistocene animal populations provide a unique new means to calibrate the rate of genetic change, and to study the behaviour of molecular clocks. This data have revealed considerable problems in the use of genetic sequences to analyse events in the recent past, such as human evolution, domestication, etc. Preliminary studies suggest that current molecular dating estimates for key events in human and Neandertal evolution are likely to have been over-estimated.

Human or non-human? Possible methods for the identification of bone fragments

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The identification of bone as human or non-human is an important task within several disciplines, including forensic science, physical anthropology and archaeology. Yet it can prove problematic if the bone is fragmented, and is too small to display any characteristic identifying features. Previous research has indicated that sufficient differences are present at the microscopic level to identify bone as human or non-human. These differences are mostly related to the appearance, type and number of Haversian systems, as observed in a section of bone. However, in many cases (particularly in archaeology) it is preferable that the bone is not destroyed for identification. Therefore, there is a need for a non-destructive method of identification of bone fragments. Ideally the method should be relatively fast and inexpensive to use, in order to have the widest applicability. Possible suggestions include a study of the surface texture of the bone, as it has been observed that this differs in appearance and “feel” between human and non-human bones.

Discovery of Middle Pleistocene fossil and stone tool-bearing deposits at Groot Kloof, Northern Cape Province, South Africa

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We report the discovery of a major archaeological and fossil bearing complex of karstic deposits in the escarpment of the Ghaap Plateau, northern boundary of the Vaal River valley, Northern Cape Province. This escarpment also contains Taung, around 100 km northwest. The region is known for open fluvial sites sampling Lower and Middle Pleistocene tool types and the long running, but broken sequence of deposits at Wonderwerk Cave. In particular, the Final Acheulian/Early Middle Stone Age or Fauresmith assemblage, associated by some researchers with earliest *Homo sapiens*, occurs in the region.

Preliminary studies of lithics suggest they sample an early MSA/late ESA type industry, with small pockets of LSA bearing breccia also occurring. Together with the suggested presence of fossils from the Florisian Land Mammal Age, a Middle Pleistocene age is inferred for these deposits. This is confirmed by a U-Th date of associated fossil bearing tufa at 248 ± 22 ka and a normal magnetic polarity. The presence of older tufa at the site is inferred from geomorphic and comparative evidence with Taung. Also associated with the deposits is a series of rock-shelters with rock art and evidence of Iron Age and LSA occupation. Their discovery, along with a further 13 archaeological localities covering the Middle Pleistocene to Holocene represents a major sequence of archaeological and fossil bearing deposits.

The inconsistency in involuntary behaviour of upper limbs: A lateral approach

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The aim of this work was to investigate possible lateralisation in the power of periodic motion of the human upper limb (or upper extremity), during normal walking at a comfortable speed of locomotion. Ten healthy preadolescent, strongly right-handed, 12-year-old males participated in the experiment. Participants were walking on a treadmill with a standardised velocity of 1.1 ms^{-1} (comfortable speed for all of them). A video analysis system with Silicone software was used to synchronically measure the different angles of both shoulders and forearms. The initial, final and interim angular positions of both shoulders and forearms in 10 cycles of each participant were compared in terms of variations (cycle-to-cycle) between both upper extremities at corresponding phases of each cycle for distal and proximal segments, respectively. We compared the coefficients of variations in relation to the spatial and temporal data of

both limbs and their angular velocities. In addition we investigated the level of cycle-to-cycle regularity (constancy) of behaviour in relation to the different positions, periods and velocities of movement of upper extremities (specifically shoulders and forearms) using the Eta non-linear method of correlation.

All participants exhibited a lower level of regularity for the lower (distal) segments. The spatial and temporal variations in the dominant limb were also greater than the non-dominant limb for all participants. This may be due to a larger contribution from the right-sided muscles that are considered to be the main contributing factor to motion of the dominant upper limb during walking rather than the simple gravity force acting alone. A possible practical application of this information may be useful in the objective clinical identification of the level of dominance of the upper extremity (shoulder plus forearm), in addition to “traditional” handedness.

Human hairline variation in the Australian population for the purposes of identification

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There is a vast amount of biological variation present both within and between living human populations. Human variation ranges from major differences such as body shape, size and skin colour to minor differences such as eye colour and eyebrow shape and allows us to distinguish between individuals. Knowledge of variation has applications in both forensic and biological anthropology where the characteristics of one individual are compared to photographs or surveillance videos for identification purposes. One facial feature not previously studied in sufficient detail is the hairline. The hairline can be used in association with other facial features such as nose and face shape to make identification more accurate. For identification in biological anthropology four hairline categories were devised by observing the hairlines of a sample of the Australian population ($N = 177:75$ males, 102 females). General descriptive statistics and the frequency of individuals in each hairline category were used to analyse the hairline measurement data. Statistically significant differences were found between males and females and the hairline categories therefore justifying hairline categorisation. For identification in forensic anthropology the previously untested hairline prediction method for facial approximation was assessed ($N = 12$) and was found to be unsatisfactory. Instead, data on hairline frequency in males and females can be used to place a hairline on a facial approximation to aid in increasing recognition rates.

Cranial trauma in pre-Angkorian Cambodia

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Excavations in northwestern Cambodia have uncovered a rich burial ground, dated to the late pre-Angkorian period, *c.* AD 75–300 AD. In addition, extensive modern looting of the site of Phum Snay has exposed a large sample of unprovenanced human skeletal material. Both sample sets were available for study but the latter is comprised of only isolated bone elements, not individuals. The analysis of this latter sample has therefore raised some interesting issues for undertaking bioarchaeological research and ensuring results are comparable with other types of datasets. An intensive period of data collection was undertaken in Cambodia earlier this year and this paper will present some preliminary results, particularly focusing on the evidence for disease and trauma. Evidence for cranial trauma was quite extensive and when this is combined with the archaeological evidence for weaponry, it may support the anecdotal evidence that these people were ‘soldiers’ or, at the very least, suggest a troubled lifestyle in the pre-Angkorian period.

Limb proportions of *Homo floresiensis*

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An analysis of the relationship between the length of the radius (estimated) and the length of the femur in *H. floresiensis* (LB1) supports the finding by Morwood and colleagues (2005) that the limb proportions of LB1 are most like those of the australopithecines. The radius was chosen for this analysis as it was not compared in the recent *Nature* paper and this, combined with different data sets for apes and *H.sapiens*, allows for an independent analysis of some of the limb proportions of LB1 (Morwood et al., 2004, *Nature*).

Reporting back to the experts: What you thought kids should know about genes and DNA

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Some of you may recall that our first study looked at the understandings that children aged 11 – 16 have about genes and DNA, and raised some issues about their conception that genes and DNA are entirely separate in structure and function.

The second phase of our study involved interviewing nine experts in the field of genetics (several drawn from the ASHB membership) to gauge their response to the understandings demonstrated by the children. This paper will report the results in some detail, but it was interesting to find that experts from different branches of the discipline have different ways of thinking about genes and corresponding disparity in the emphasis desired upon genotype versus phenotype. However, there was general agreement that genetics is best taught early, in context and that the role of the environment should be emphasised more than is currently the case in the curriculum. The results of this work has guided our further research currently being conducted in classrooms and reported on elsewhere at this Conference.

Establishing understandings of genes and DNA

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This paper will report on the ongoing third phase of our research into student conceptions of genes and DNA. With the advice from our experts that these understandings should be established earlier, this work commenced with a year 2 class (students aged around 7 years of age) in an Islamic Primary School in Perth. Having ascertained that these students had a reasonably robust theory of biology (i.e. understandings of living vs non-living things), and that only two had heard of DNA, they were considered to be an ideal group with which to work. Two lessons were designed and delivered by one of the researchers in conjunction with the classroom teacher, to consolidate their present understandings and introduce these concepts. Two weeks later, the students were re-interviewed, with encouraging results. Subsequently this work has been repeated with a year 9 class and a year 12 class, at different levels of complexity. This paper will present detailed results from the year 2s and preliminary results from the year 9s and 12s. Another major focus of this paper will be a new and simple model for presenting these concepts that has evolved during this research.

The impact of depression on success of a short-term weight loss programme among obese females

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Women with depressive symptoms sometimes experience weight gain. Our study investigates whether depression influences success in weight loss programmes. This was investigated with 90 Western Australian females participating in a 12 week cognitive-behavioural weight management programme. Mean weight loss was 3.36 ± 3.40 kg (mean \pm SD). Weight loss was negatively correlated with levels of depression ($r = -0.37$, $p < .01$) as hypothesised. Possible moderators of this relationship, including emotional

eating, attention to eating patterns and exercise, were then investigated. Emotional eating (eating to regulate negative mood) significantly inhibited weight loss only in moderately to severely depressed women; in non-depressed women weight loss was similar with high and low levels of emotional eating (3.7% and 3.5% weight loss, respectively). Depressed women may fail to lose weight if they pay less attention to maintaining their weight loss programme. This was estimated by how well they claimed adherence to the specified energy intake limit (adherence). Adherence was negatively related to level of depression and positively related to weight loss. However, depressive symptoms still had an independent relationship with weight loss after controlling for adherence. Participation in an exercise programme offered as part of the weight management programme was not related to depressive symptoms and did not lead to greater weight loss. Results indicate that symptoms of depression should be addressed prior to treatment for weight loss and that weight management programmes may need to be modified to increase the likelihood of success for those with high levels of depressive symptoms.

The use of focused life histories and linear enamel hypoplasia to help explain intergenerational variation in relative sitting height within Taiwanese families

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Evidence suggests that familial genetic variation contributes substantially to variation in relative trunk and leg lengths among individuals. There is also growing evidence that ecological factors interact with genomes in poorly understood ways to variably influence the distribution of adult body form. A recent review of secular changes in stature reports that in a majority of groups with positive secular trends, increases in leg length have been greater than those for trunk length. Male and female outcomes within these groups are not always consistent, though. Studies of parents and offspring in the US have also yielded similarly inconsistent results not easily interpreted with available evidence.

The present study contributes to the debate by taking advantage of the sometimes dramatic change in developmental environments experienced by Taiwanese parents and their young adult children. It tests the hypothesis that a significant percentage of variation in parent–offspring differences in relative sitting height (sitting height/height \times 100) may be accounted for by intergenerational environmental change. The extent of intergeneration change in environments was independently assessed using environmental rankings based upon life history data and/or differences in the prevalence of linear enamel hypoplasia. Analyses were accomplished with and without adjustment for parental aging effects.

Significant intergenerational declines in relative sitting height were found using unadjusted ($\Delta = 0.58\%$, $p \leq 0.0005$) and adjusted data ($\Delta = 0.68\%$, $p \leq 0.0005$). A mixture model controlling for numbers of children per family indicates that intergenerational differences based upon life history data do account for a small but significant percentage of variation in body proportion differences ($p = 0.04$).

Inclusion of differences in linear enamel hypoplasia ($p = 0.04$) weakens this association. However, when five atypical mother–daughter pairs with unusually large declines in relative sitting height and large increases in stature are removed, differences based upon life history data are more strongly associated ($p = 0.005$), with the effect of differences in LEH prevalence remaining ($p = 0.04$).

Thermal adaptations and clothing in Aboriginal Australia

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While Australian Aborigines at the time of first White contact generally wore no clothing of any kind, those in the cooler parts of the continent often made use of simple cloaks as thermal protection. A systematic review of ethnographic evidence in relation to meteorological indices confirms an essentially thermal pattern of indigenous clothing use, with the apparent paradox that the thermal trend is reversed in Tasmania. This paradox is explored in relation to principles of human thermal physiology and the role of biological adaptations to cold, the development of which can reduce any thermal need for clothing. It is concluded that the Tasmanian Aborigines used neither more nor less clothing than they needed, which happens to be less than what was needed by some Aboriginal groups on the mainland. The ethnographic paradox, in other words, is resolved. These findings, it is suggested, have broader anthropological implications, of which the most obvious relate to general theories of clothing origins. However, prehistoric evidence suggests that Tasmanians developed more sophisticated clothing during the last ice age. An abandonment of clothing by Tasmanian Aborigines during the post-glacial epoch is explicable as a thermal adaptation. It does, however, raise the question of why some human cultures could readily dispense with clothing when it was no longer needed for reasons of warmth, while others, now the vast majority if not the totality of human cultures, find clothing indispensable for a multitude of reasons.

Manual asymmetry – view towards peripheral approach

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Within the overall context of motor behaviour it is generally accepted that the vast majority of people demonstrate a pronounced asymmetry between the hands in performance, usually favouring the right hand and that this demonstration of handedness may well be the clearest example of behavioural lateralization in humans. The peripheral approach to the problem of lateralization in relation to isolateral differences between mechanical properties of identical hand muscles is scarcely represented in literature.

The primary objective of this work was to measure and compare some visco-elastic properties (extensibility, stiffness and energy of resistance to deformation) of the

bilateral identical distal hand muscles under tensile stress. The sample of 13 preserved cadavers included nine males (between 65 and 96 years) and four females between 63 and 90 years old. All cadavers were preserved with an ethanol glycol mixture containing less than 1% formaldehyde. First dorsal interosseous (FDI) muscles from both hands were dissected and attached to a measuring device designed to produce graduated stretching in the vertical direction. A graduated strain (stretch) was then applied to the attached muscle using a rotational clamp that translated the movement into a vertical migration along a fixed bar governed by a scaled Vernier calliper (each graduated movement was equal 0.5 mm). The corresponding force, produced by the tensile stress of the stretched muscle during each step of the movement was measured and recorded by a force meter scaled to kilograms (kg) with 0.05 kg graduations on the scale. We investigated the relative level of the maximal strain and total visco-elastic energy of each sample of muscle tissue using adaptation of specific mathematical technique.

Our results demonstrate that there was no significant group difference in percentile strain between left and right muscles. The rupture point (the amount of force at the moment of visible separation of muscle tissues) was significantly greater on the right, than on the left, however, in six cadavers the rupture point was greater on the left than on the right. There was no difference in the total specific visco-elastic energy, associated with the full range of stretch between left and right, however, in two cadavers there was the greater amount of energy on the left than on the right. From the literature it is clear that there is no simple relationship between cortical dominance and dominance of the force of muscle contraction in the muscle of the dominant hand especially in relation to grip force.

Our study supports the trend in the literature that peripheral influences imply the existence of functional states at the periphery that are not always cortically influenced. However, *in vivo*, these potential states of peripheral autonomy are likely to be cortically conditioned within the overall field of motor control. This assertion supports Bernstein's overall view that a complimentary interplay exists between cortical and peripheral levels inclusive of the peripheral capability to modify and influence cortical responses. The postmorbidity state is deemed a purely physical state and residual energy is stored in inert tissue. Thus we support current trends in the literature to develop a deeper level of understanding of the complex issues underpinning the central–peripheral relationship.

Behaviour of mechanical properties of animal skeletal muscle related to tone under *in vitro* compression: Report 1

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Stedman's Concise Medical Dictionary defines tonicity of biological tissues as "a state of normal tension of the tissues by virtue of which the parts are kept in shape, alert and ready to function in response to a suitable stimulus". Subjective

techniques are widely employed for measuring skeletal muscle tone while objective methods are scarcely used in clinical and research practice, because there is no precise description of this natural phenomenon in physical terms.

Our aim was to propose adequate quantified indices reflecting muscle tone, based on the pure physical internal properties of skeletal muscle such as stiffness, compliance, toughness, fragility, resilience, damping and viscoelasticity. We used the load deformation relationship of a skeletal muscle rooted in the model of its stress-strain behaviour. The gross animal muscle was subsequently automatically compressed and decompressed in the vertical direction by a special bar with a cross-sectional area of 113 mm² that moved with constant speed (0.43 mm/s). The automatic equipment developed by the authors allows the objective and rapid measurement of multiple characteristics of muscle tone.

We used *gluteus maximus* muscles from five young male cows 3–4 years old, using two portions of 0.7–1 kg from each muscle. The quality of meat in each portion was estimated as very high with a minimal amount of connective tissue. Each portion was initially prepared by being cut into a regular quadrilateral shape with two horizontal surfaces. The superior (experimental) surface of each portion was labelled with 12 landmarks for measurements. Because our experimental muscles were totally denervated we were able to focus on the purely physical properties of the muscle.

The experiments demonstrated that the most important characteristics representing the tonicity of muscle are: Young's modulus (the gradient of the total stress–strain curve), toughness modulus (strain energy absorbed per 1 mm of deflection) and resilience (amount of energy returned during unloading as a percentage of the amount of energy absorbed during loading) and others.

The “Gladiator” from Pompeii (79 AD, Italy)

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The possibility that the skeleton of a male in his forties belonged to one of the gladiators of Pompeii, is discussed. The skeleton was excavated in 1998 near the city walls, and in the vicinity of one of its gates in the North–East part of the ancient town, which was buried under volcanic ash in the 79 AD eruption of Vesuvius.

Preservation of the skeleton is nearly complete with only few smaller bones missing. Extensive data collection included measurements of the skull, postcranial skeleton and teeth, observations of pathological changes on bones and teeth, observations of non-metric characteristics on the skull, teeth and postcranial skeleton, and occupation marks.

The stature of the individual was 1596 mm. The bones were very robust with very well marked muscle attachments. A marked asymmetry in length of humeri, right being 7 mm longer than left, and in the glenoid fossa measurements was observed. There was no asymmetry in the lower extremities. The index of robusticity was calculated for long bones and results were compared with indices for the entire

sample from Pompeii. Pathological signs included healed fracture of three ribs with the sixth right rib broken twice, bone growth on femur probably due to muscle injury and extensive osteoarthritic changes on vertebrae and around surfaces of the following joints: hips, knees, ankles, elbows, shoulders and small joints.

Morphometric analysis of selected marsupial scapula

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This project aims to investigate morphological variations of scapulas in different species of marsupials, and to relate these differences to their unique functional characteristics. This study concentrates on six broad species of marsupials; koalas, kangaroos, quolls, bandicoots, possums, and wombats. These were subsequently set in context against a small array of further mammals, including some eutherians, including the flying fox.

The underlying principle of form follows function is a major theme in this study. Attempts at identifying patterns are based on this fundamental assumption, and throughout this study, the evidence that form follows function is strong, and helps to explain the many aspects of marsupial anatomy and biomechanical function.

Operation Cawdor and the Nias Island incident – DVI considerations

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Forensic odontology has been responsible for the vast majority of the positive identifications to date from the disaster victim identification (DVI) process following the Thai tsunami, and the identifications of the nine victims of the RAN Sea King crash on Nias Island. This paper compares the approach to the DVI process in these two incidents in terms of their commonalities and differences, with particular reference to the command structure.

Russell Lain has had three deployments to Thailand as Team Leader Dental of the Australian Federal Police contingent, and was responsible for co-ordinating the dental identification process following the Sea King incident.

The genetic landscape of tissues

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We are familiar with the idea that differences between DNA sequences can be used to define relationships between different humans. We inevitably think of DNA sequence variation in protein coding regions as being a single measure, albeit with

complicated phenotypic consequences depending on what proteins are influenced by genetic variations.

I am going to show that the influence of genetic variation on the expression of genes creates a far more complex relationship because the influence is tissue specific. I will show this by discussing our own work using mouse models which shows that the influence of genetic variation on gene expression is almost entirely tissue specific. This means that the genetic “distance” between two individuals (or two species for that matter), varies depending on the tissues that are being compared.

The observations have important implications for understanding morphological evolution and more practically upon studying human variation. If we wish to study the influence of genetic variation upon gene expression in relation to, for example, human diseases, then we necessarily have to study affected tissues and this creates substantial ethical and practical difficulties.

Are there phenotypic differences between the S252W and P253R genotypes within Apert syndrome?

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Apert syndrome is characterised by craniosynostosis, midface hypoplasia and syndactyly of the hands and feet. Almost all cases of Apert syndrome occur as the result of one of two mutations of the fibroblast growth factor receptor 2 (FGFR2) gene resulting in an amino acid substitution of either S252W or P253R.

The aim of this study was to determine if there are differences in morphology or neuropsychological performance between those patients with Apert syndrome and the S252W mutation and those with the P253R mutation.

This was a retrospective study of 35 patients. CT scan data were reconstructed and on each scan 88 osseous landmarks were determined on the calvarium and facial bones with a particular emphasis on the sphenoid bone. These osseous landmarks allowed shape analysis and the generation of a series of anthropometric variables including distances, angles and indices that were compared with normal data. Shape analysis was performed using generalised Procrustes analysis and principal component analysis (GPA/PCA). Syndactyly severity was assessed according to Upton’s classification, the presence or absence of a cleft palate was ascertained and neuropsychological assessments were undertaken. A meta-analysis was performed using the existing published data.

In this series we were unable to detect any reproducible differences in the shape of the pre-operative craniofacial skeleton. Meta-analysis of this series and the existing published data showed association of cleft palate with the S252W mutation and more severe syndactyly with the P253R mutation. There does not appear to be an associate ion between genotype and intelligence quotient (IQ).

Behaviour of mechanical properties of animal skeletal muscle related to tone under in vitro compression: Report 2

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The objective of this study was to differentiate the transverse mechanical properties of skeletal muscle relating to muscle tone and variations of these variables in different samples of the same muscle in a number of examples. Compression–decompression experiments were performed on five gluteus maximus muscles of young male cows (3–4 years old), 24 h after being butchered. All cows were from the same farm. Three main physical variables were determined during the period of compression and decompression: Young's modulus, specific elastic energy and muscle plastic set.

There were small coefficients of variation between the selected variables within each portion (sample) of meat (4–10%). However a big difference was found between different animals. The specific energy of compression and decompression varied between 3.061 and 4.265 mJ/mm (50%) and 1.207–5.112 mJ/mm (36.598%), respectively. The Young's modulus varied between 0.252 and 0.732 N/m (28.4%) and 1.207–5.112 N/m (36.598%). The plastic set as a difference in deflection between compression and decompression varied between 10.15 mm and 18.5 mm (23.6%).

The results demonstrate that muscle stiffness (Young's Modulus) and level of internal resistive elastic energy to deformation, both important derivatives of muscle tone, have great variation between different individuals.

These mechanical indexes may interactively represent not only the chemical constitution of the contractile and elastic elements of muscle (the concentration of myosin, actin, titin and desmin) but also may reflect the effect of intra- and extracellular fluid on the mechanical properties. We plan future experiments to investigate this problem.

Cranial morphological variation in the Matjes River Rock Shelter collection

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Original assessments of the skeletal remains from the Matjes River Rock Shelter site suggested multiple biological populations relating to the main stratigraphic units. The biological populations were defined on the basis of changes of cultural material and a few physical characteristics. As part of a larger study the author has looked at reassessing the theory of multiple biological populations, from the cranial remains of the Matjes River Rock Shelter site. This was more difficult than anticipated due to

the fragmentary nature of the collection and the loss of crucial stratigraphic data in association with the cranial remains. The known stratigraphic groups were characterised through canonical variates analysis (only three of the five groups were analysed in this way as two stratigraphic contexts had less than three individuals in the sample), and discriminant analysis (classification) was used to predict the stratigraphic groups of the unassigned individuals. The stratigraphic groups were then re-characterised to determine the effect of the predictions. Discriminant function analysis was then used to determine if the stratigraphic groups showed significant differences from each other. Separation of the biological populations and their affinities to the current South African populations (a comparative data set of known origin) is also tested in this way.

The role and implementation of forensic archaeology into existing AFP DVI response procedures

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The capability of forensic response units within Australian Law Enforcement and Defence agencies has increased exponentially in response to terrorist threats. An equivalent reaction is occurring in areas of scientific research and development. Specialised disciplines of forensic science such as post-blast analysis, methods of individual identification (including DNA) and disaster victim identification (DVI) scene management have come to the fore. Therefore, any introduced procedures must be adapted to suit existing chain of command structures, reporting lines and operational field procedures.

The National Institute of Forensic Science (NIFS) Michael Duffy project (2004/5) aims to develop general procedures in forensic archaeology within the existing DVI framework in order to stimulate awareness of archaeological principles in Police exhumation operations. From the investigation perspective, information that a specialist area provides, must add value to the overall investigation by either proving or disproving facts in issue. Therefore, any methodologies that are integrated into forensic operating procedures should address police investigation needs, and be aligned with the accreditation requirements. Understanding and familiarisation of these procedures could potentially generate a greater demand for forensic archaeology on both a national and international level.

Unlike previous studies this project has the advantage of working from within a law enforcement agency. Its objective is to establish an ongoing liaison role between Australian Federal Police (AFP) Forensic Services and external experts, thus creating a functional and effective communication conduit.

Within the AFP, DVI is now classified as an operation division of (Forensic) Counter-Terrorism. Consequently, forensic archaeology/anthropology has a new dimension in both operational and research potential.

Human anthropophagy in the New Guinea colonies

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The man-eating myth (Arens, 1979) concluded that no reliable eyewitness reports of cannibalism exist despite the very large number of references to it in anthropological and other publications. Here, several reports from the early colonial period of the New Guinea colonies are considered. Reliable and substantial evidence of cannibalism will be presented which sheds light on the ecological role of this practice in the region.

Palaeohealth in Hokkaido, Japan: Jomon and Okhotsk communities

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The aim of this paper is to investigate general physiological well-being and oral health using skeletal and dental remains from the Jomon and Okhotsk culture periods of Hokkaido, Japan, curated at the Sapporo Medical University. Specifically, physiological health was assessed by way of the frequency of cribra orbitalia and linear enamel hypoplasia. Oral health was examined by way of a number of traits: carious lesions, alveolar defects of pulpal origin, abscesses, ante mortem tooth loss, ante mortem tooth trauma, tooth wear, calculus and extra-masticatory wear facets. Comparisons with other Asian prehistoric samples and ecologically similar assemblages (Inuit for example) are made and the implications of the results are discussed.

Muscles and molecules: Development and evolution

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The superficial temporal muscle of non-human primates is absent in most humans. Yet the associated fasciae (and rare muscular anomalies) exist in all humans like “ghosts” of a once present muscle (Oxnard, 1983/1984, *The Order of Man*). This implies temporalis muscle reduction in humans in the past and is associated with skull gracilisation. Reduction of first branchial arch musculature in the human head domain is known to derive from gene inactivation of a myosin heavy chain (MYH 16) occurring after the chimpanzee/human split (Stedman et al., 2004, *Nature*)

Could something similar have occurred in the human forelimb domain? Thus, the dorsoepitrochlearis muscle of non-human primates exists in only 5% of humans. Yet the associated fascial sheets are always present and occasionally there is an

anomalous muscle. Most other forelimb muscles are also smaller and less complex in humans than in other primates, but muscular variations and persistent fascial sheets imply that greater size and complexity were once the norm. The reductions are associated with skeletal gracilisation. This is not true of the human hindlimb.

Is it possible that a molecular phenomenon, not unlike that producing reduction of the jaw muscles in creatures with reduced need for powerful mastication, may also have reduced forelimb muscles in creatures no longer having locomotor usages of the forelimb? If so, could this molecular change be dated (as it has been for mastication)? It would be fascinating if the best evidence for the timing of truly human bipedalism were in forelimb development rather than hindlimb fossils! Supported by the Leverhulme Trust (UK) and the Australian Research Council.

Patterns of biological variation along the north east coast of the Indian Ocean

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Natural catastrophes disrupt humanity and the patterning of biological variation shaped by our evolutionary history. In spite of that, evolutionary processes such as selection and gene flow produce patterns in biological variation that may be examined with reference to geographic distance. Three analyses are used to examine the nature of this relationship along a 7000 km stretch of the north east coast of the Indian Ocean, from the Ganges Delta, through Myanmar and the Malay Peninsula to the Indonesian Archipelago. These are summary biometric differences, Isolation by Distance, and Isolate Differentiation.

Average biometric distances vary between 1.05 for Moulmein and 1.76 for Flores. Those that appear most distinctive from the rest are islands: Flores, Nicobar, Sumatra and Andaman in that order. Isolation by Distance analyses produce strongly systematic results over the length of this coast. In order to assess how different island populations might be, isolate differentiation ratios, scale island difference to mainland diversity.

Each of these analyses contributes to a view of how gene flow operates in the region, with island groups less different than expected, especially for the Nicobar and Andaman groups. Although distinct it is also apparent that these island populations have participated in the regional gene flow that serves to link populations. The antiquity of these patterns may not stretch back to original colonization (1.75 million years under a regional continuity model; 60,000 years under replacement), but must have a considerable antiquity.

A reassessment of the “gracile” vs. “robust” dichotomy in the Pleistocene of Australia

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Pleistocene human crania from Australia have been assigned to “gracile” and “robust” categories as descriptors of their size and morphology. These categories have likewise been cited as evidence for the existence of multiple founding populations for the continent. Individuals from the Willandra Lakes region are commonly used to support these hypotheses as they appear to exhibit great variation in cranial robusticity. Contributions to this discussion have so far neglected the relatively large post-cranial sample available from the region. This paper will assess the validity of claims for multiple populations being represented in the post-crania from the Willandra Lakes.

Our team collected an exhaustive battery of post-cranial measurements from the available Willandra Lakes skeletal sample, including both the specimens published by Webb (1989) as well as a number of undescribed individuals discovered more recently. These measurements will be compared to a number of Australian samples both from the Pleistocene as well as the Holocene, in an effort to examine whether Willandra Lakes post-cranial material falls within the range of variation for other, modern and ancient, Australian populations.

Our results suggest that the terms “robust” and “gracile” may only be useful for the discussion of Australian crania and not appropriate in the description of post-cranial samples. For example, the Lake Mungo three individual is commonly considered to be “gracile” and yet exhibits a large and relatively “robust” post-cranial skeleton. Further, our findings cast doubt on the presence of two separate populations being represented in the post-cranial sample from the Willandra Lakes.

Cribra orbitalia as a correlate of sedentism

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Australian models of pre-contact Aboriginal lifestyle have been influenced in part by palaeopathology. Based on North American models, where high levels of porotic hyperostosis and cribra orbitalia have been found in association with agriculture, aggregation and sedentism, high levels of cribra orbitalia in populations from the Murray River have been inferred as a correlate for similar patterns of settlement. Australia displays a different pattern of lesion distribution, however, suggesting a different aetiology. Using the clinical literature, it has previously been demonstrated (Stuart-Macadam, 1987) that two of the assumptions relating to the interpretation of

cribra orbitalia can be disproved. In view of these findings, cribra lesions in Australian Aboriginal populations have been re-evaluated with respect to iron requirements and infection. The results suggest that cribra is not a ready indicator of sedentism and aggregation, and that current models of Aboriginal lifestyle should be reviewed.

Observed variations of the paranasal sinuses by computed tomography in Melanesian skulls: A forensic perspective

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Radiography has a long history of aiding forensic investigators in identifying human remains. Computed tomography (CT) has greatly increased the radiologist's ability to observe individual specific variation. In particular all of the paranasal sinuses, not just the frontal sinuses can be assessed. Researchers looking at the paranasal sinuses for clinical studies have found a range of common variations in the population. It has been suggested that abnormal frequencies in Asian subjects, compared to Caucasoids may be due to racial variation. If this is true, then physical anthropologists may be able to use observations of the paranasal sinuses as an additional method for the assessment of race and personal identification. This study aimed to observe the incidence of common variations of the paranasal sinuses in 42 Melanesian skulls using CTs. In addition, measurements of anthropological significance were taken.

CT scans using 1.5 mm thick slices were obtained for each skull. These were then reformatted using DI-COM imaging software and optimised for observing each variation. Measurements were taken using digital sliding and co-ordinate calipers. The results of this study were compared to those of similar studies reported in the literature. The outstanding results from this study in comparison to previous studies are discussed in regards to their possible use in forensic anthropology.

Form and function of the marsupial pelvis: A multivariate study

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Thirteen measurements of the pelvic girdle of selected marsupial species were taken to best represent functional attributes of this structure. Following preliminary studies, 11 variables were selected and subjected to multivariate analyses: those of principal components analysis (PCA) and canonical variates analysis (CVA).

The PCA produced clusters separating marsupial groups according mainly to size and shape. The first three components contained over 97% of the total variance in the data. The first PC described largely size-related morphology while the second and third described largely shaped related morphology.

Canonical Variates analysis described groups previously defined upon the basis of species. Functional “closeness” of the groups was portrayed by the distance between them, measured in standard deviation units. While plots of the first and later variates were functionally revealing, a plot of the third and second was particularly so; clear functional trends of decreasing arborealism were evident in this plot. Similarly, a clear separation was noted of “bipedal” macropods from “quadrupedal” non-hopping marsupials. It was thus pleasing to note that the *statistical* discrimination described by the CVA clearly coincides with *biological* and may be interpreted in clear functional terms.

The use of multivariate analyses in finding answers to biological questions does not hide or disregard biological information, but in effect highlights it. The question of “function” has always been a question of “form”; employing statistical techniques is merely a mechanism of examining the latter to understand the former.

Patterns of morphological variation in the marsupial humerus and femur: A morphometric analysis

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The humerus and femur of selected marsupials were studied in order to establish their functional affinities. A suite of data was collected from each bone from approximately six specimens each of bandicoots, quolls, koalas, wombats, possums and wallabies. All dimensions were chosen so as to represent functionally important attributes of the two bones. A univariate analysis was undertaken which produced interesting but essentially simplistic results; the data was then subjected to the multivariate techniques of principal components analysis (PCA) and canonical variates analysis (CVA).

The PCA, of the humerus and femur, individually and jointly, displayed overall size along the first component. However, functionally important shape information was obtained on later components. The canonical variant analysis produced notably greater functional attributes of the bones when looked at both individually and collectively. While plots of CV1 against later variates produced much interesting information, the greatest degree of functional discrimination was found in a plot of the third and second variates. Here, an obvious delineation of functional attributes was obtained, from “digger”, to “land dweller” up to “tree climber”. There were separations even amongst these distinct groups, with respect to the quoll that spent minimal time climbing, were slightly closer to the climbing group while the wallaby was a definite land dwelling animal, even though these two came into the category of land dwellers.

The degree of function discrimination was greater in the integrated analysis of the two bones; this finding provides support for the notion of “total morphological pattern” as proselytised by the late Professor Sir Wilfred Le Gros Clark and provides a caveat against treating isolated parts as if they were independent structures.

What is the real age of Adam and Eve?

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Mitochondrial Eve and Y-chromosome Adam have had a profound influence on the later stages of human evolution research. MtDNA and Y-chromosome data have pointed to the geographic origins of our species, strongly supported the Recent Out of Africa concept, used to estimate the timing of major migrations and been important in demographic reconstructions in several areas. The completeness of the basic sampling of variation in living people is the key to the accuracy of the resulting analyses, be they dates or places or theoretical constructs. We believe that the global variation has been dramatically underestimated because there has been a major bottleneck, which began some 15,000 years ago and, from reading today’s paper, is a bottleneck that may not yet have reached its peak.

The Lapita cemetery at Teouma, Vanuatu

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The Lapita site of Teouma, on the island of Efate, Vanuatu, was discovered in 2003, when Lapita pottery was found during earthmoving operations in the area. The nature and importance of the pottery was recognized by a field worker from the Vanuatu National Museum in Port Vila and led to the excavation of the site over two seasons in 2004–2005, under the directorship of Dr. Stuart Bedford and Prof. Matthew Spriggs of ANU, and the Vanuatu National Museum. The site was found to be not only Lapita but also a cemetery and has resulted in the recovery, for the first time, of a significant sample of Lapita burials. Over the two seasons, remains from 31 individuals have been recovered, increasing the number of skeletons ascribed to Lapita people by 200%.

Although the sample is not yet necessarily representative of the cemetery population, for the first time there is the opportunity to begin to describe the real Lapita people, learn about their quality of life and describe their morphology. It may now be possible to determine their role in the human settlement of the Pacific directly rather than by inference from artifactual and linguistic evidence. This paper describes the burials and presents some preliminary findings from the examination of the skeletons. These people engaged in burial practices involving dismemberment

and removal of skulls. The skeletons show that members of this Lapita community were a very robust, hardworking people with significant health problems.

MtDNA diversity in Aboriginal Australians and near neighbours

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From currently available mt genome sequences of living Aboriginal Australians, five major mtDNA haplogroups are identifiable. They are called AuA, AuB, AuC, AuD, and AuE. Haplogroup AuB belongs to global lineage ‘M’, and the others to ‘N’. Within N, AuA can be allocated to sub-division ^NS, AuD to ^NO, while AuC and AuE fall into haplogroup ^{N(R)}P. On available evidence, ^SAuA, ^MAuB, ^PAuC and ^OAuD are widespread in Australia.

Comparison with mt genomes from near neighbours that include people from Papua New Guinea (PNG), Andaman and Nicobar Islands and Malaysia reveals that Australian haplotypes are distinct, linking only at the base of clades in phylogenetic trees. A few, including M and ^NP sequences group closely to some coastal and highland PNG sequences indicating some ancient connection. However, the Australian ^MAuB sequences do not include any from the subgroup ^MQ that is common in Papua New Guinea and Island Melanesia and which is purported to have expanded in the region (Friedlaender et al., 2005, Merriwether et al., 2005). Australian specific diversity indicates genetic isolation over a long period during which there was apparently very little gene flow between Australia, PNG and other near neighbours. Estimates of time depth using coalescent analysis supports a continuity of presence for the descendants of the first founders well established by perhaps 40,000 years ago.

Reconstructing species migrations from a simulated fossil record

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The problem of reconstructing phylogenies using morphological data of current and fossil species, already very difficult, is further complicated when migration has played a significant role. In this talk, I will present the results of various simulations of the evolutionary process, including mutation, fitness, interbreeding, fossilisation and migration, and focussing on reconstructing the migration history.

Specific questions of interest are; how apparent are the migrations in the fossil record, what kinds of errors of reconstruction are most easily introduced, and when is there an intermediate continent in a surviving lineage’s migration history, what is the likelihood of finding fossils from that particular lineage on the intermediate continent?

The particular context employed is the evolution of hominoids over the past 25 million years. Three continents, representing Africa, Europe and Asia, are simulated, with many more species in the past than the present, and allowed migrations broadly corresponding to historical periods of connectedness and isolation. The simulations cover various aspects of this problem, including different fossilisation patterns, the impact of interbreeding, differential fitness between new migrants and established species on each continent, various mutation models, and changes to the rates and periods of migration.

The most significant result is the consistent and substantial under-representation of surviving lineages in the fossil record of the intermediate continent (i.e. Europe), and the consequent impact on both the reconstruction process and determination of the time and location of common ancestors.

Visualising mismatch distributions and site-frequency spectra in non-ideal populations

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An important problem in population genetics is that of determining a population's demographic history based on its current genetic diversity. One major complicating factor is the difficulty of distinguishing between a change in population size and the action of various kinds of selection. For example, a selective sweep and a sudden population expansion look alike since both imply a rapid increase in the number of carriers of a particular allele.

Two measures of genetic diversity in a sample are the “mismatch distribution”, i.e. the distribution of genetic differences between pairs of individuals, and the “site-frequency spectrum”, that measures the frequency in the sample of the mutant form at any polymorphic site. In an ideal case, when a population undergoes a sudden expansion, evidence of the expansion will be visible according to both of these measures: the mismatch distribution will show a unimodal wave, and the site-frequency spectrum will show an excess of sites with a rare mutant state.

The purpose of this study is to use computer simulation to see how this ideal picture is altered by including effects such as recombination, and allowing the rate of mutation and recombination to vary both between genes and over time. In addition, the simulations allow experimentation with population profiles other than just a sudden expansion. Mitochondrial, Y-chromosome and nuclear loci are simulated and can be followed simultaneously, and the development over time of the mismatch distribution and the site-frequency spectrum in each case are visualised by computer animation.

Reconstruction of body mass/height and other variables from isolated distal parts of the hindlimb

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A morphometric study was carried out using the calcaneus and distal end of the tibia of humans to assess their ability to predict body mass and height. A suite of linear measurements was collected from the calcaneus and tibia of 25 female and 25 male Zulu specimens from the Dart collection housed in the University of Witwatersrand, Johannesburg, South Africa. This data set was combined with that previously collected from the talus of the same specimens (reported in Turnbull, 2003, HOMO) in order to ask and answer further questions regarding their relationship with each other.

Initially, an array of univariate analyses was undertaken which revealed useful, though essentially simplistic trends in morphology and predictions of human stature. The data was then subjected to a multivariate analysis, principal components analysis, which revealed considerably greater detail with regard both to morphology of the parts and to body stature. The multivariate analyses revealed both the calcaneus and tibia to be excellent indicators for human height, but less so for mass. This is thought to be largely a result of the quality of the mass data, being obtained *post mortem*. This finding is in keeping with that of Turnbull (2004).

As an adjunct study, the first principal components of the three bones were plotted against each other to assess their relative gradients. A simple null hypothesis of an equal increase in overall size, as judged by their first principal component, was rejected; thus we find a “relative size” relationship with respect to these three parts, thus reflecting an essentially allometric relationship of size.

Morphological discrimination in the human metatarsus: The relationship between structural variability, habitual behaviours and environment

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A suite of linear measurements were collected from the metatarsal elements of three recent South African human sub-groups (Zulu, Sotho and European) and a sample of pre-pastoral *Holocene* individuals from the Southern Cape, dated 9750–2000 BP. The recent humans were associated with modern lifestyles, and the pre-pastoral individuals with habitually unshod forager societies. Pre-pastoral foragers are well-suited to relevant investigations of the relationship between habitual behaviour and bony morphology. The data were used to examine patterns of variation within and between the groups with the view of determining if functional adaptation as a result of lifestyle may be discriminated. A range of univariate

analyses were undertaken which showed important yet simplistic trends in variation. Subsequent multivariate analysis revealed very subtle yet verifiable patterns of variation broadly discriminating between the Bantu subgroups (Zulu and Sotho) and Europeans on the one hand and the pre-pastoral (Khoisanoid) subgroup on the other. Most of this variation appears to be genetic, followed by a functional or habitual behaviour-based discrimination between the recent humans and the pre-pastoral foragers. South African Khoisan foragers, together with some Ethiopians are thought to share the deepest clades of the human Y-chromosome phylogeny. This suggests that both the European and the Bantu speaking Africans are genetically more distant from the Khoisan than from each other. The exact nature of this discrimination is therefore not entirely clear; hypothetically, another sample of a recent Khoisanoid subgroup would be required.