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Italian - Australian Archaeology and Cultural Heritage Workshop

New Scientific Techniques in Archaeology, Palaeo-Anthropology and Cultural Heritage

14 - 17 March 2011
Rydges Hotel - Cronulla - Sydney

Office of the Scientific Attaché
Embassy of Italy, Canberra

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Introduction

This workshop is promoting exchange and collaboration amongst Italian, Australian and international experts from across the spectrum of the natural sciences and the humanities. Focus on the impact of recent analytical technological developments in applications to pre-history, human dispersal across the globe, paleo-anthropology and archaeology.

The workshop will deal with a variety of interdisciplinary areas, in particular the latest scientific tools in radiometric dating, molecular and isotopic analyses, and spectroscopic and structural studies using advanced radiation techniques operating at unprecedented levels of sensitivity and accuracy.

These nuclear-based techniques can provide isotopic characterisation of biological, organic and terrestrial samples of most types; provide chemical, spatial and temporal information of objects leading to identification and mapping of the climate, geology, and anthropological environment; as well as perform non-invasive studies of irreplaceable works of art.

Time	Monday 14 March	Tuesday 15 March	Wednesday 16 March	Thursday 17 March
8.30 am				**Human origins**
9.00 am		**Human origins**	**Paleobiography**	
10.00 am				Coffee break
10.30 am		Coffee break	Coffee break	**Analytical techniques**
11.00 am		**Chronologies**	**Analytical techniques**	
12.00 pm				**Wrap up**
12.30 pm	Arrival and Registration	Lunch	Lunch	Lunch
1.30 pm				**Visit ANSTO**
2.00 pm	**Opening / welcome**	**Human origins**	**Analytical techniques**	
3.00 pm	**Science for cultural heritage**			
3.30 pm		Coffee break	Coffee break	
4.00 pm	**Human origins**	**Pacific Prehistory**	**Analytical techniques**	
5.30 pm				**Depart ANSTO**
7.00 pm	**Dinner / talk**			

Map


Kurnell Rd
Gosport St
Croydon St
Kingsway
Elouera Rd
Rydges Hotel
Wilbar Ave
Croydon St
Gerrale St
Purley Pl
Cronulla St
Croydon St
Cronulla
Ferry Wharf
Cronulla
Train Station
Laycock Ave
N
100m

Organising Committee

Claudio Tuniz
The Abdus Salam International Centre for Theoretical Physics, Italy

Oscar Moze
Scientific Attaché, Embassy of Italy, Australia

Anton Stampfl
Chair

Joseph Bevitt
ANSTO

Herma Buttner
ANSTO

David Fink
ANSTO

Rhiannon Still
ANSTO

Cherylie Thorn
ANSTO

Michael Zettinig
ANSTO

Richard Gillespie
Archaeology & Natural History, Australian National University and
Centre for Archaeological Science, University of Wollongong

Programme

Day 1 - Monday, 14 March

12.30 pm **- 2.00** pm	Arrival and registration
2.00 pm **- 3.00** pm	**Opening / welcome** Chaired by: **Oscar Moze** Scientific Attaché, Embassy of Italy **Les Bursill** Chair of the Sutherland Shire Aboriginal Advisory Committee **Benedetto Latteri** Consul General, Embassy of Italy **Mary Finlay** General Manager, International Science & EIF Branch, Department of Innovation, Industry, Science and Research
3.00 pm **- 3.30** pm	**Science for cultural heritage** Chaired by: **George Thompson** ICTP Trieste Science for Cultural Heritage **Claudio Tuniz** ICTP Trieste and UoW
4.00 pm **- 5.30** pm	**Human origins** Chaired by: **Colin Groves** ANU Scapular glenoid morphology in the genus *Homo* by geometric morphometrics: the position of LB1(*Homo floresiensis*) **Giorgio Manzi** U Rome The first humans in Italy. What do we really know about chronology? **Giovanni Boschian** U Pisa Laser Ablation ICP-MS scanning of isotopes in human fossils **Rainer Grün** ANU
7.00 pm **- 9.00** pm	**Dinner / talk** The struggle for human evolution **Colin Groves** ANU

Day 2 - Tuesday, 15 March

9.00 am **- 10.30** am	**Human Origins** Chaired by: **Collin Murray-Wallace** UoW *H. floresiensis* - what it is, what it isn't, what it means **Debbie Argue** ANU Shifting paradigms: how research in East Asia and Australasia is revolutionising our understanding of human evolution **Darren Curnoe** UNSW Late Pleistocene/Holocene human populations transition in the Old World: the analysis of morphological dental traits **Alfredo Coppa** U Rome
10.30 am **- 11.00** am	Coffee break
11.00 am **- 12.30** pm	**Chronologies** Chaired by: **Rainer Grün** ANU The game of radiocarbon dating and calibration **Quan Hua** ANSTO Advances in OSL dating and recent archaeological applications **Bert Roberts** UoW Burial dating in archaeology using Be-10 and Al-26 cosmogenic radioisotopes **David Fink** ANSTO
12.30 pm **- 2.00** pm	Lunch
2.00 pm **- 3.30** pm	**Human Origins** Chaired by: **Alfredo Coppa** U Rome The craniomandibular mechanics of being human **Steve Wroe** UNSW Records of Environmental Change and Megafaunal Extinction from Southern Australia **Gavin Prideaux** Flinders U The craniomandibular mechanics of being human **Steve Wroe** UNSW

3.30 pm **- 4.00** pm	Coffee break
4.00 pm **- 5.30** pm	**Pacific Prehistory** Chaired by: **Mariaelena Fedi** INFN and U Florence Simple tools, complex technology: How direct dating has revolutionised our views of the prehistory of Island Southeast Asia **Sue O'Connor** ANU New directions in the study of ancient obsidian trade in Papua New Guinea: assessments of portable X-ray fluorescence and portable Raman spectroscopy **Robin Torrence** Australian Museum Dating the initial arrival of people to the islands of East Polynesia **Janet Wilmshurst** Landcare Research NZ

Day 3 - Wednesday, 16 March

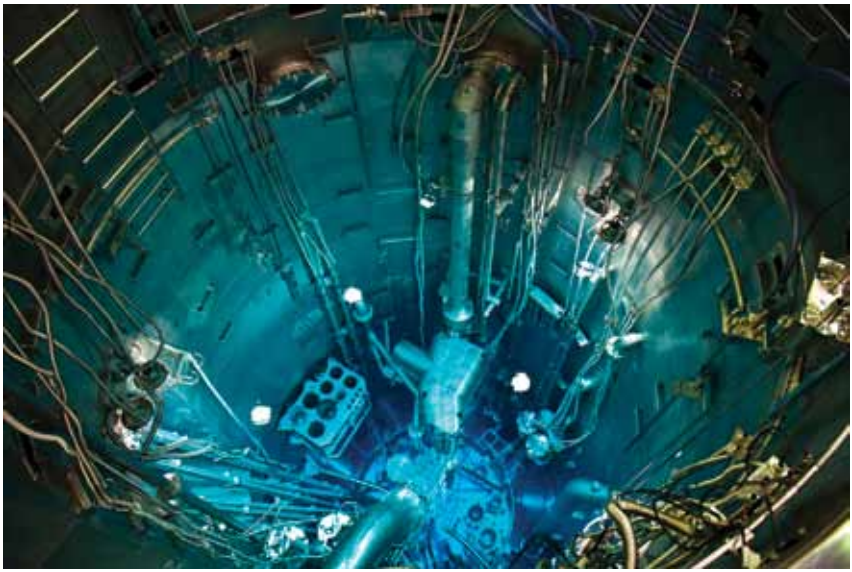
9.00 am **- 10.00** am	**Paleobiology** Chaired by: **Sheila van Holst Pellekaan** UNSW Using new ancient DNA methods to record human evolution and migration, and to reveal the impacts of climate change **Alan Cooper** U Adelaide X-ray computed microtomography of primates' hyoid bones: implication for language evolution **Ruggero D'Anastasio** U Chieti
10.00 am **- 10.30** am	**Panel discussion** about Analytical Techniques
10.30 am **- 11.00** am	Coffee break
11.00 am **- 12.30** pm	**Analytical Techniques** Chaired by: **Keith Fifield** ANU Accelerator based analytical methods in cultural heritage diagnostics: applications of IBA and 14C-AMS dating in archaeological sciences **Gianluca Quarta** University of Salento AMS and IBA for Cultural Heritage **Mariaelena Fedi** INFN and U Florence A novel methodology for mortar radiocarbon dating **Filippo Terrasi** 2nd University of Naples
12.30 pm **- 2.00** pm	Lunch
2.00 pm **- 3.30** pm	**Analytical Techniques** Chaired by: **Gilberto Artioli** U Padova Shedding light on the past **Anton Stampfl** ANSTO Neutron Scattering and Neutron Imaging teaming up to brighten up the Past **Roberto Triolo** U Palermo Neutron scattering and neutron diffraction for cultural heritage **Vladimir Luzin** ANSTO

3.30 pm **- 4.00** pm	Coffee break
4.00 pm **- 5.30** pm	**Analytical Techniques** Chaired by: **Steve Wilkins** CSIRO Advances in cultural heritage X-ray microstructural analysis at Elettra **Franco Zanini** Sincrotrone Trieste New directions in the study of ancient obsidian trade in Papua New Guinea: assessments of portable X-ray fluorescence and portable Raman spectroscopy **Karen Privat** UNSW Archaeometallurgy at large scale facilities: new tools for old metals **Gilberto Artioli** U Padova

Day 4 - Thursday, 17 March

8.30 am **- 10.00** am	**Human origins** Chaired by: **Darren Curnoe** UNSW Faunal biogeography in Southeast Asia: implications for hominin dispersals **Mike Morwood** UoW In search for the *Homo floresiensis* ancestors: excavating Pleistocene sites on the islands Flores and Sulawesi, Indonesia **Gert van den Bergh** UoW Genetic heritage: from the living present to the past in Australia **Sheila van Holst Pellekaan** UNSW
10.00 am **- 10.30** am	Coffee break
10.30 am **- 12.00** pm	**Analytical Techniques** Chaired by: **Filippo Terrasi** U Caserta Pushing the Radiocarbon limit in Australian archaeology **Keith Fifield** ANU Imaging Paintings with Synchrotron Radiation **Deborah Lau** CSIRO Advanced X-Ray Imaging Techniques for Cultural Studies **Steve Wilkins** CSIRO
12.00 pm **- 12.30** pm	**Wrap-up:** **Claudio Tuniz** and **David Fink** Outcomes of the workshops
12.30 pm **- 1.30** pm	Lunch
1.30 pm **- 5.30** pm	**Visit ANSTO**
5.30 pm	**Depart ANSTO:** Bus will depart ANSTO at **5.30pm** Drop offs at Sydney Domestic Airport and Sydney Central Railway Station

The OPAL building at ANSTO



The OPAL reactor pool

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Science for Cultural Heritage

Claudio Tuniz

The 'Abdus Salam' International Centre for Theoretical Physics, Italy
University of Wollongong, Australia

Cultural heritage commonly refers to buildings, statues, art, tools, weapons and other human artifacts, mostly made during the Holocene, following the spread of the first farmers and the development of large human settlements. It also includes the products of Pleistocene hunters-gatherers, such as rock art, ivory figurines, musical instruments and ornaments. Cultural heritage can be extended to include the first rudimentary stone tools produced by more archaic humans.

The precious bones of ancient hominids and proto-hominids are also part of our cultural heritage. I will briefly review advanced scientific tools and procedures, mainly developed in basic physics research, which can be used to characterise cultural heritage materials without damaging them. ICTP and ELETTRA laboratories in Trieste are building new devices that can be used for in-situ chemical and morphological analyses in remote archaeological sites.

These portable systems, designed for multiple analyses, such as x-ray fluorescence, x-ray diffraction and microtomography, can be also used in museums, galleries and restoration institutions for precious and non-movable objects. Status and perspectives of our collaborative programme will be discussed, including preliminary results of interest to palaeoanthropology and human evolution.

Scapular glenoid morphology in the genus Homo by geometric morphometrics: an explorative approach to LB1 (*Homo floresiensis*)

Fabio Di Vincenzo, Giorgio Manzi

Dipartimento di Biologia Ambientale, SAPIENZA Università di Roma, Italy

Despite the scapular glenoid fossa (SGF) is an anatomical detail, its morphology has received a special attention from scholars of human evolution. Looking at the scapula as a whole, it is conceivable that different components provide a mosaic of features. Some traits, possibly including SGF, are moderately influenced by epigenetic modifications, reflecting a strict genetic control. Thus, these traits may suggest interesting peculiarities of different taxa in terms of their respective evolutionary histories.

In order to discriminate between conflicting signals affecting morphology, geometric morphometrics provide a powerful tool. Thus, we used a 2D-semilandmarks approach to address a comparative study on the shape of the SGF, with particular attention to modern and archaic humans as well as to Plio-Pleistocene hominins. In the framework of this study, we present here an explorative approach applied to the SGF of LB1 from Liang Bua, Flores (Indonesia).

The analysis describes a rather continuous transition from the plesiomorphic condition of *Australopithecus* to variants of the genus *Homo*, appropriately ordered according to their respective chronologies and phylogenetic positions. In this framework, the LB1's SGF finds a position as the most plesiomorphic pattern of the genus *Homo*, close to the specimen D4166 from Dmanisi, Georgia. This result is consistent with previous studies on postcranial human elements from Liang-Bua, supporting the attribution of the hominin from Flores to a distinct species of "early *Homo*".

The first humans in Italy. What do we really know about chronology?

Giovanni Boschian

Università di Pisa – Dipartimento di Scienze Archeologiche 53, via S. Maria – I-56100, Pisa, Italy

The Italian territory and its sites with hominin remains play an outstanding role in the framework of the early human colonisation of Europe. Since the way from Africa through Sicily has never been open to early human migration, the North of Italy acted as an East to West corridor, between the constraints of glaciers advancing from Central Europe during the ice ages, and of the sea rising from the South when the ice was melting.

Human fossils and cultural remains found in the Italian sites, together with chronology data, indicated that the peninsula was occupied by more or less distinct human lineages during subsequent waves of settlement starting from about 800 ka. However, this perspective is now partly changing after some of these sites were rejuvenated by revisions of their chronology: at present, these data are suggesting the coexistence of these lineages within the same territory, and may even take back the ghost of the so called “short chronology”.

These considerations show that a general revision and refinement of the dating of the early Italian sites is necessary, together with a check of their stratigraphic setting; long and well-dated reference sequences should be used for correlation. Within this framework, the Visogliano shelter may play a remarkable role. The 10 m-long sequence of this Middle Pleistocene site situated in North-eastern Italy was dated to 350-500 ka by combined ESR/U-series analyses, and includes human remains and archaic stone tools that show affinities with assemblages of older and contemporaneous sites in Italy and in Europe.

Laser Ablation ICP-MS scanning of isotopes in human fossils

Rainer Grün

Research School of Earth Sciences, The Australian National University, Canberra ACT 0200

Laser ablation combined with multi-collector ICP mass spectrometers allow least destructive analysis of a wide range of isotopes. Applied to human fossils, it can be used, for example, for U-series dating, or the reconstruction of human migrations using Sr isotopes. The systematic mapping of U-series isotopes led to revisions of the ages of a series of prominent human fossils, as for example, the Wadjak specimen. The detailed U-series analysis of a small bone fragment of the Omo 1 fossil made this the oldest directly dated modern human. We have developed a rapid scanning method that allows to check the suitability of human fossils for dating before any cuts are carried out for detailed analysis.

Sr isotope mapping allows the identification of domains in teeth that were unaffected by diagenetic overprints. This is essential for the reconstruction of migration patterns of prehistoric populations.

The struggle for human evolution

Colin Peter Groves

School of Archaeology & Anthropology, Australian National University, Canberra, ACT 0200

The idea that humans are animals took a long time to take root in Western culture. Even after the idea of evolution came to be widely accepted, human pride was salvaged by mounting an argument that our ancestors separated from other animals a very long time ago. Every advance in our understanding of the place of humanity in the animal kingdom, every significant fossil documenting the course of human evolution, has been stoutly resisted. Two steps forward, one step back...

H. floresiensis – what it is, what it isn't, what it means

Dr Debbie Argue

Research Fellow, School of Archaeology and Anthropology, College of Arts and Social Science, Australian National University, Canberra, Australia

Six years ago the discovery of a small partial skeleton attributed to a new hominid species, *Homo floresiensis*, caused a sensation - headlines swept around the world, blog pages were crammed, controversy reigned. Such a tiny being – one meter tall, with a very small brain – c. 400 cubic centimeters, but, improbable as it seemed, it was dated to 18,000 years ago – another species of *Homo* living at the same time as us! Such a scenario could hardly have been envisioned before this remarkable discovery.

Since then, a great deal of work has been undertaken and many papers published. Yet two opposing views persist: that, as originally published, it is a very early, archaic, member of our genus; and that it is a modern human with pathology.

This presentation will discuss what *H. floresiensis* is, what it isn't, what it means for our paradigms of human evolution, and where to from here.

Shifting paradigms: how research in East Asia and Australasia is revolutionising our understanding of human evolution

Darren Curnoe

School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, NSW, 2052, Australia

East Asia was at the vanguard of palaeoanthropological research during the latter nineteenth and first half of the twentieth centuries. However, World War II, the end of European colonialism and subsequent political upheavals across the region especially in China saw research attention shift to Africa and Europe during the second half of the twentieth century. All this is now changing: growing international engagement with East Asian scholars and international collaborative efforts are beginning to produce radical shifts in our understanding of human evolution.

The discovery of *Homo floresiensis* in Indonesia provides a compelling example of how a single locality can transform 150 years of palaeoanthropological thinking and radically shape our understanding of recent human evolution. Further, it is becoming increasingly clear that a large part of the hominin evolutionary story has been overlooked because research has focused too much on the African lineage leading to modern humans. To develop this theme further, I will draw on new discoveries from East Asia including my own research on the late Pleistocene hominin record of southwest China.

It is becoming clear that East Asia will further shift paradigms in human evolution in unexpected ways including understanding of the role played by archaic hominins in the emergence of modern humans as well as our impact on these extinct species.

Late Pleistocene/Holocene human populations transition in the Old World: the analysis of morphological dental traits

Alfredo Coppa

Dipartimento di Biologia Ambientale, SAPIENZA Università di Roma, Italy

The Pleistocene/Holocene transition was marked by a profound shift in nutritional patterns. Such change, alongside with human demic movements, altered the genetic background of the Old World population. The biological relationships among Upper Paleolithic and Neolithic African, European and Asian human groups have been analyzed by means of morphological dental traits that have proved to be highly discriminant in phenetic analyses among populations because of their abundance, strong hereditary component and low environmental influence.

In the present study, we analyzed the frequency of 49 morphological dental traits (26 maxillary and 22 mandibular) in 18,377 teeth from 3,918 specimens divided in 20 groups (9 belonging to the Final Pleistocene from North Africa, Middle East, south east Asia and Europe, and 11 to the Holocene from North and Sub-Saharan Africa, Arabia, south east Asia and Europe).

The relationships between these groups were assessed applying the standard statistical techniques used in the analysis of genetic data (MMD, Multidimensional Scaling, Maximum Likelihood, Principal Components and Cluster analysis), which produced similar outputs.

Preliminary results indicate homogeneity among the Upper Paleolithic and Neolithic samples from Europe, Middle East, North and Sub-Saharan Africa. In contrast, the Iberomaurusians of Afalou and Taforalt form a separate cluster together with the Saharan Neolithics and the Neolithics from Ras al Hamra 5 in the Sultanate of Oman. As regards the south-eastern Asian groups (Cambodia and Vietnam), the Neolithics present similarities with their European and African coevals, while the Paleolithic groups tend to present some degree of divergence.

The research was supported by “Progetti di Ateneo” Università di Roma “Sapienza”.

The game of radiocarbon dating and calibration

Quan Hua

Institute for Environmental Research, ANSTO

Archaeologists and geoscientists rely on continuous improvement in radioisotopic chronological techniques to generate accurate and reliable calibration curves by which measured data can be converted into an absolute age scale.

Various archives are included in providing radiocarbon data sets for calibration – tree rings, corals, marine and lake sediments, and possibly some speleothems. This has generated a number of calibration curves and statistical age-depth models. The IntCal Radiocarbon Working Group recently released a terrestrial and marine radiocarbon calibration curve (IntCal09 and Marine09) from 0 to 50 ka which effectively spans the full sensitivity of the AMS method.

However all archives other than tree rings (0-12 ka of calibration curve) do not reflect contemporary atmospheric ^{14}C content. Dissolved inorganic ^{14}C in corals and forams varies with CO_2 exchange at the atmospheric-ocean interface and admixture of ^{14}C depleted carbon from deep upwelling waters. Total ^{14}C in speleothems depends on the admixture of ^{14}C depleted CO_2 from soil and/or rock carbonate. Hence a dead-carbon fraction or reservoir correction (modelled or otherwise) must be included to convert measured radiocarbon to atmospheric equivalent prior to inclusion into a universal calibration curve.

These complexities, the different calibration curves and web-based programs will be discussed and presented.

Advances in OSL dating and recent archaeological applications

Richard 'Bert' Roberts, Zenobia Jacobs

Centre for Archaeological Science, School of Earth & Environmental Sciences, University of Wollongong, NSW 2522, Australia

Optically stimulated luminescence (OSL) dating has been used increasingly over the past decade to develop chronologies for archaeological deposits, objects of material culture, faunal remains, and sedimentary archives of environmental change. In part, its increased popularity reflects the capacity of OSL dating to provide calendar-year ages for events beyond the range of radiocarbon dating and in contexts where suitable materials are absent for radiocarbon, uranium-series, electron spin resonance and other numerical dating techniques.

The range of OSL dating extends from a few years to several hundreds of thousands of years, and can be used to obtain burial ages for sediments that were exposed to sunlight immediately prior to deposition. Instrumental and methodological developments have facilitated the dating of individual grains of sand, which provides a means to check that sediment grains were exposed to sufficient sunlight before burial and not mixed afterwards. Quartz has generally been the mineral of choice, but considerable progress has been made recently with potassium feldspars.

In this presentation, the principles of OSL dating will be summarised, and its potential and limitations illustrated with some archaeological, palaeoanthropological and palaeontological examples from Australia, Africa and Asia.

Burial dating in archaeology using ^{10}Be and ^{26}Al in-situ produced cosmogenic radioisotopes

David Fink

Institute for Environmental Research, ANSTO

Dating sediment associated with archaeological artefacts and hominid fossils over the Plio-Pleistocene is difficult due to the limited range of radiocarbon, U-series and OSL techniques, with magnetostratigraphy being the only dating tool to offer chronological constraints.

Recently a new innovative technique - in-situ cosmogenic burial dating – can provide burial ages from 0.5 to 5 Ma with errors of about 10%-15%. Galactic cosmic ray particles which interact with bedrock surfaces and boulders on the Earth's surface result in producing a host of long-lived cosmogenic radionuclides (eg ^{10}Be and ^{26}Al). If we know the production rate of these radioisotopes, their half-life and can measure their minute concentration via AMS, we can estimate the time the bedrock or boulder has been exposed.

If this material after initial dosing is transported to depths a few meters below the surface, production will cease, and decay will reduce their concentrations. The change in concentration is a measure of the burial age. If burial depth is insufficient, post-burial production by deep penetrating muons can be estimated to correct the burial age. The method has been successfully applied at key sites of hominid evolution. Details of the technique will be presented with examples of burial dating hominid cave deposit.

The craniomandibular mechanics of being human

Stephen Wroe[1,*], Toni Ferrara[1], Colin R. McHenry[1,2], Darren Curnoe[1], Uphar Chamoli[1]

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[2] School of Engineering, University of Newcastle, NSW 2308, Australia

[*] Author for correspondence (s.wroe@unsw.edu.au)

Diminished bite force has been considered a defining feature of modern *Homo sapiens*, an interpretation inferred from the application of two-dimensional (2D) lever mechanics and the relative gracility of the human masticatory musculature and skull. This conclusion has various implications with regard to the evolution of human feeding behaviour.

However, human dental anatomy suggests a capacity to withstand high loads and 2D lever models greatly simplify muscle architecture, yielding less accurate results than three-dimensional (3D) modelling using multiple lines of action. Here, in the most comprehensive 3D Finite Element Analysis performed to date for any taxon, we ask whether the traditional view that the bite of *H. sapiens* is weak and the skull too gracile to sustain high bite forces is supported. We further introduce a new method for reconstructing incomplete fossil material.

Our findings show that the human masticatory apparatus is highly efficient, capable of producing a relatively powerful bite using low muscle forces. Thus, relative to other members of the superfamily Hominoidea, humans can achieve relatively high bite forces, while overall stresses are reduced. Our findings resolve apparently discordant lines of evidence, i.e., the presence of teeth well-adapted to sustain high loads within a lightweight cranium and mandible.

Records of Environmental Change and Megafaunal Extinction from Southern Australia

Gavin Prideaux

School of Biological Sciences, Flinders University

What caused many of the world's larger terrestrial animals to become extinct during the Late Pleistocene? This is arguably the most enduring and debated topic in Quaternary science. In Australia, which lost 90% of its larger vertebrate species, three potential causes have been isolated: human hunting, human firing of the landscape, and increased aridity.

The only thing more difficult to find than direct evidence of interactions between early Australians and large Pleistocene animals is someone lacking an opinion on what killed the giants off. How can we definitively solve this problem? Well, we can't, not without a Time Machine, but what we can do is improve the confidence limits on hypotheses by filling in gaping holes in underlying datasets. We need to know how species, both those that became extinct and those that survived, were distributed through space and time.

We need a better understanding of species ecologies. We need to track the nature of biotic responses to environmental changes. We need good regional climatic and fire records. We also require a better understanding of the timing of human arrival in different areas. My team's research combines classic palaeontological approaches (e.g., field excavations, anatomical and ecological analyses) with more novel methods, including stable-isotope geochemistry and enamel microwear.

It is poised to begin incorporating data from microCT and synchrotron analyses of teeth to retrieve further adaptive and ecological information. Here I review four of our recent studies that have shed light on the impacts of environmental changes on Pleistocene mammals and the nature of the extinction process in southern Australia.

The consensus seems to be that the ultimate cause was complex and that human hunting, fire and climate change all played some role, with their relative importance likely varying between species and region. Ultimately, though, if we remove humans from the equation, it seems likely that most if not all Late Pleistocene giants would have survived to the present day.

Scientific analyses of stone axes: reconstructing Neolithic long-distance connections in north-eastern Italy

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Archaeometric studies, carried out on Neolithic and Copper Age polished stone axes from North-Eastern Italy and neighbouring countries, have allowed to define the most used raw materials and their modification through time [1-3]. Depending on the archaeological issues and the mineralogical and chemical features of the investigated rocks, different analytical strategies have been used - from optical investigations and XRD analyses to EMPA, ICP-MS, micro-computed tomography and synchrotron radiation techniques.

In Europe, the most important raw materials used for the production of Neolithic axe-heads are the high pressure metaophiolite rocks (mainly eclogites and jades) originating from North-Western Italian Alps [4,6] and amphibole-rich metabasites outcropping in Northern Bohemia (Czech Republic) [7].

Our studies have shown that jade and eclogite axe blades reached the Neolithic groups of North-Eastern Italy and coastal Croatia for the first time in the second half of the 6th millennium BC, during the Danilo/Vlaška Culture. It is only in the first half of the following millennium that similar tools entered inside central Slovenia. In the same period, long and accurately polished jade axes started to be widely distributed in Western Europe over distances up to 1700 Km [5].

The first production and exchange of Northern Bohemian metabasite axe blades and shoe-last axes were linked to the development of Central European Linear Pottery Culture in the second half of the 6th millennium BC. Shortly after the beginning of the 5th millennium BC, a shaft hole was added to the shoe-last axe, producing a peculiar type of shaft-hole axe, which has been in use during the Stroke-Ornamented Pottery, Rössen and Lengyel Cultures (5th millennium BC) [8]. Our recent archaeometric analyses have revealed that such type of very long shaft-hole axes, distributed in a large part of central and south-eastern Europe, crossed the Alps and reached north-eastern Italy too.

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Two completely different types of stone axes, the HP metaophiolite axe blades and the Northern Bohemian metabasite shaft-hole axes, representative of two distant Neolithic traditions, were both present in North-Eastern Italy during the 5th millennium BC. The ceremonial jade axes have been interpreted as sacred objects and material markers of great significance and high social value [5], on the contrary the function of long Bohemian shaft-hole axes is still debated [8]. Their exceptional dimension, in comparison to other shaft-hole axes from the region, is a probable clue of the importance and symbolic meaning of these tools for the local Neolithic groups.

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Simple tools, complex technology: How direct dating has revolutionised our views of the prehistory of Island Southeast Asia

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The last decade has seen an increase in the use of fine resolution excavation and recovery methods, and the application of AMS radiocarbon dating to individual cultural finds from stratified archaeological sequences in Island Southeast Asia (ISEA). As a result many of the orthodox boundaries for cultural change, such as the ISEA 'Neolithic', have been blurred, or become conceptually redundant. The application and innovation of chronometric dating methods to rock art has also provided new insights into the symbolic concerns of the makers of the artefacts. In this paper I discuss specific examples where direct dating has revolutionised our understanding of the prehistory of our region.

New directions in the study of ancient obsidian trade in Papua New Guinea: assessments of portable X-ray fluorescence and portable Raman spectroscopy

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The study of ancient obsidian trade in the Pacific region has long benefitted from PIXE-PIGME chemical characterization of obsidian artifacts, but new research questions demand less costly techniques to ensure larger and more representative samples. In addition, portable instruments are required for non-destructive analysis of artifacts held in museum and private collections. To meet these needs the success of PXRF and portable Raman in discriminating among obsidian sources from Papua New Guinea, based on a large and comprehensive reference sample, was assessed and trial runs using obsidian artifacts housed at Museum Victoria were compared.

Dating the initial arrival of people to the islands of East Polynesia

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The archipelagos of East Polynesia were among the last places on earth settled in prehistory. However, colonization chronologies vary by >1000 years on many islands, causing radically divergent interpretations of human dispersal and ecological impacts.

We analysed 1434 radiocarbon dates from the 15 main archipelagos in East Polynesia using a 'top-down' evaluation of the entire archaeological radiocarbon database. Radiocarbon dates, irrespective of stratigraphic context, were categorized to obtain a conservative subset of the most reliable dates.

This subset of short-lived materials have the fewest sources of error from inbuilt age, dietary or post-depositional contamination, and yield precise calibrations close to the 'true' age of the event being dated. Cumulative probabilities of these ages were analysed to provide the most precise estimates yet for colonization on each archipelago, and showed that East Polynesia was colonized in two phases: first, the Society Islands ~AD 1025-1120, four centuries later than previously assumed; and second, dispersal in one major pulse to all remaining islands ~AD 1190-1290.

Previous chronologies rely on radiocarbon-dated materials with large sources of error making them unsuitable for precise dating of recent events. Our shortened chronology now offers explanation for the remarkable uniformity of East Polynesian culture, human biology, and language.

Using new ancient DNA methods to record human evolution and migration, and to reveal the impacts of climate change

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Genetic information recovered from ancient biological materials (principally teeth and bones) provides a unique means to record evolutionary processes in real time, and assess the biological effects of climate change and human impact across time and space.

By accessing DNA from large numbers of dated individuals, it is possible to genetically characterise ancient populations and cultures, and to examine the timing and effects of past extinctions, colonisations, and genetic bottlenecks in the Late Quaternary. This work has revealed a remarkably dynamic picture of evolutionary and ecological change, not visible to the fossil record, with a potentially major role played by climatic change.

New methods to recover bacterial DNA from dental calculus have created a new field of research for biological anthropology, and opened the way to detailed studies about the evolution of disease, and impacts of behavioural and cultural transitions.

Studies of evolutionary change using ancient DNA also confirm that the molecular clock has significant problems when applied to the recent past, and is likely to yield misleadingly results about the timing of a range of Quaternary events.

X-ray computed microtomography of primates' hyoid bones: implication for language evolution

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The evolution of human language is of crucial interest to anthropologists. The origin of modern speech has been related to indirect anatomical, genetic and social arguments[1-6]. Studies conducted on fossil remains[7-11] suggest that modern macroscopic morphology of the hyoid bone might have been developed by *Homo* in the Middle Pleistocene[10]. Here we present a comparative analysis of the microstructure of hyoid bone in non-human primates, extinct and extant humans. X-ray computed microtomography was the method of choice, allowing a non-invasive structural examination with micron resolution, comparable to conventional histological analysis[12].

We compared the microarchitecture of hyoid bones from extinct and modern humans and non-human primates. Cercopithecoid hyoids are constituted by a bone tissue with low or absent metabolic activity. Hyoids from pre-Neanderthals, Neanderthals and modern humans present histological structures that are typical of a bone involved in intense metabolic activities. Only Kebara 2 hyoid bone presents a histological architecture comparable to modern *H. sapiens*. Anyway it shows some histomorphometrical aspects, that could be a manifestation of individual histological variability, or an expression of some biomechanical and physiological own proprieties for Neanderthals.

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Accelerator based analitycal methods in cultural heritage diagnostics: applications of IBA and ^{14}C-AMS dating in archaeological sciences

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Analytical methods based on the use of electrostatic accelerators with terminal voltages in the megavolt range have now established as powerful tools in the field of cultural heritage diagnostics. In particular IBA (Ion Beam Analysis) techniques and AMS ^{14}C dating have largely demonstrated their potentialities in Archaeological sciences where the high level of achievable sensitivity represents a crucial advantage with respect to more traditional analytical methods.

The accelerator based facility at the University of Salento (CEDAD-Centre for Dating and Diagnostics) in Lecce, Italy will be presented. The centre is based on a 3 MV Tandetron accelerator equipped with five experimental beam lines for AMS ^{14}C dating, RBS-Channeling, PIXE-PIGE analyses in external beam mode, ion implantation and nuclear microprobe. The main features of the AMS and PIXE-PIGE beam lines, more relevant in cultural heritage diagnostics, will be presented and discussed in terms of achievable sensitivity levels, precision, accuracy and analytical flexibility.

Different cases of study will be presented, putting in particular emphasis on the potentialities given by the combined application of IBA and ^{14}C dating for the study of the same archaeometric problem. The identification of the provenance of obsidian samples found in Neolithic contexts ^{14}C dated to the fifth millennium BC, the compositional analysis and the dating of the casting cores recovered from the Riace bronzes, the analysis of the diagenetic state of radiocarbon dated cremated bones from Bronze age sites in Northern Italy represent some of the cases which will be discussed.

AMS and IBA for Cultural Heritage

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Ion Beam Analysis (IBA) and Accelerator Mass Spectrometry (AMS) are accelerator-based nuclear techniques that have by now become an important tool to support scholars and restorers in their studies.

Among IBA techniques, in particular Particle Induced X-ray Emission (PIXE) allows us to analyse the composition of materials in a non destructive and non invasive way. Even though, in the recent years, other physical techniques for compositional analysis have been developed, PIXE still offers interesting opportunities, especially thanks to the possibility of easily mapping the target surface. Actually, by collecting the emitted X-rays as a function of the x-y coordinates within the bombarded area, it is possible to reconstruct elemental maps, each map describing the spatial distribution of a given element. Depending on the experimental set-up, we can choose to scan either smaller areas (~mm^2) with a higher spatial resolution (few microns) or larger areas (~cm^2) with a lower spatial resolution (few hundreds of microns), thus opening the way to different applications.

AMS applied to ^{14}C dating is worldwide well known. One of the main advantages in ^{14}C-AMS is perhaps the fact that we can date samples of mass as small as a few mg. Indeed, this allows us to date very precious objects even by collecting more than one sample, thus improving the precision and the accuracy of the measurement, meanwhile reducing the impact.

In this presentation, the above issues will be discussed by showing some examples of PIXE and ^{14}C measurements performed at the INFN-LABEC laboratory in Florence.

A novel methodology for mortar radiocarbon dating

Filippo Terrasi

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Mortars represent a class of building and art materials that are widespread at archaeological sites from the Neolithic period on. After 40 years of experimentation, the possibility to evaluate their absolute chronology by means of radiocarbon (^{14}C) remains still uncertain. Using a simplified mortar production process in the laboratory environment, this study shows the feasibility of a novel physical pre-treatment for the isolation of the atmospheric $^{14}CO_2$ signal absorbed by the mortars during their setting. Isotopic (^{13}C and ^{14}C), %C, X Ray Diffractometry (XRD) and Scanning Electron Microscopy (SEM) analyses were performed to evaluate the accuracy of the proposed methodology and to draw important conclusions about the significance of the previously proposed dating methodologies.

The protocol allows suppression of the fossil carbon (C) contamination originating from the incomplete burning of the limestone during the quick lime (CaO) production, providing unbiased dating for the produced “laboratory” mortars. Our results on stable carbon isotopes raise a criticism about the stable isotope back correction proposed for the fossil C contamination suppression.

Shedding Light on the Past

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The Amuq valley or plain of Antioch, located in the Hatay province of south central Turkey, has been densely inhabited by humans for some 9,000 years. The plain provides a fruitful ground for archaeological study due to the abnormally large number of preserved ancient sites found there. Surrounded by mountains on all sides and fed by three rivers, the fertile valley provides an opportunity to study the relationship of ancient man and his environment in microcosm.

The floor of the valley has been the home of several lakes: some of the largest archaeological sites existing in the mid-late Holocene appear to have been located near-by the Lake of Antioch which evolved during this period.
A sedimentary core, representing an estimated 7,000 years of history, was taken from the lake. Synchrotron x-ray fluorescence measurements were performed on sections of the core. Analysis yielded the distribution of elemental masses spanning from Ca to Mo as a function of depth from the surface.

Figure 1 shows the results for Cu. Changes in elemental concentration with time reflect the changes in the local environment at the time of deposition. Higher concentrations of copper may reflect metal working activities: there is a maximum in Fig. 1 around 5000 BP, a high period in settlement history.

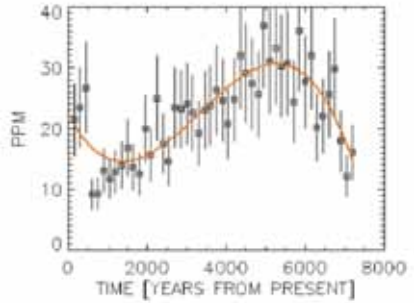

Figure 1

Elemental concentrations measured follow a number of distinct patterns that may be related to local geomorphology and climate. In this fashion a historical account of the development of the Lake of Antioch was constructed from the data.
The ebb and swell of the lake as well as changes in the local river courses directly influence man's presence in the region. Signals of such environmental change can be discerned from tracking diachronic changes in elemental concentrations throughout the sediment core. These elements serve as proxies for environmental change, both human and climate induced. The data suggest that man's activities may have aggravated some of the erosional processes.

Neutron Scattering and Neutron Imaging teaming up to Brighten up the Past

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The search for non invasive and non destructive techniques is fundamental in Archaeometry. This is absolutely true when dealing with samples of great historical, cultural and artistic value as well as with samples strongly degraded. Neutron Diffraction (ND), in conjunction with other neutron based techniques (i.e. Small Angle Neutron Scattering (SANS), Ultra Small Angle Neutron Scattering (USANS), Neutron Radiography (NR), Neutron Tomography (NT) and in general Neutron Imaging) appears to be a useful technique for testing objects of artistic or archaeological interest.

In fact, neutron techniques are non invasive, and therefore able to investigate also items very old (essentially no time constraint) and fragile; in addition thermal neutrons are able to penetrate thick layers of sample. Therefore, samples of greater volume than the ones allowed with other probes can be investigated. In addition, the combined use of these techniques allows to explore a wide range of dimensions, going from the microscopic (nm or fractions of nm) to the mesoscopic and to the macroscopic range (mm or fractions of mm).

A variety of different materials can be investigated, all of great importance in Archaeometry. As an example in recent years there has been considerable interest in the characterization of white marbles used in ancient monuments and works of art, with the purpose of tracing their provenance. Such identification is important for a number of reasons like substitutions, restorations and copies, reconstruction of commercial connections and of the paths of maritime or terrestrial routes, just to mention a few.

Many museums around the world, such as the Musei Capitolini (Rome), Antikenmuseum (Basel), the Louvre (Paris) and the Metropolitan Museum of Art (New York), have started extensive research for the identification of marbles. When marbles are considered, a combination of ND, SANS and USANS, allows to fingerprint these important materials; additional information is obtained by means of Neutron Imaging which allows to get composition information.

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This last technique, whose use for archaeometric purposes is quite recent, with the first report dating back to 1996, applied to lead ingots recovered from sunken ships, allows a unique epigraphic analysis of this objects, giving the possibility to trace the origin of the material and the manufacturer.

Finally the ability of thermal neutrons to penetrate thick layers of metals (up to 3 cm of steel) makes NT a unique tool to investigate metal samples like historical weapons even when they are covered with thick calcareous concretions. A few selected example of applications of Neutron Techniques to Archaeology and Cultural Heritage will be presented and discussed.

Neutron scattering and neutron diffraction for cultural heritage

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Neutron reactor and spallation source facilities provide a wide range of neutron experimental techniques that can be employed in the characterization of cultural heritage objects. The main advantage of neutrons is their high penetration as they enable the non-destructive and non-invasive analysis of bulk objects deep into their interior. In the first part of the presentation a selection of the neutron scattering techniques, which can be traditionally offered at neutron facilities, will be covered. In the second part, an ongoing study of Carrara marble samples will be considered in greater detail.

It is based on application of the neutron diffraction techniques such as powder diffraction for phase analysis, texture measurement and stress analysis. Original (residual) and temperature induced stresses distributions have been measured in the two main phases of marble (calcite and dolomite) to study the elastic response of the marble samples during temperature changes. This non-destructive stress analysis is intended to elucidate possible stress-induced mechanisms of marble deterioration caused by daily or seasonal temperature cycling. The link of stresses to other phenomena like micro-cracking and large-scale bowing in will be also discussed.

Advances in cultural heritage X-ray microstructural analysis at Elettra

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Conventional analytical techniques to study the microstructure of ancient samples are destructive and do not give access to their three-dimensional structure. It is necessary to use a non-invasive method to avoid any damages to the cultural and paleontological remains, which are a non-renewable resource.

The third generation synchrotron radiation source of the SYRMEP beamline appears as a well suited investigation tool for paleoanthropology and cultural heritage, due to beam monochromaticity - which avoids beam hardening artifacts on the images, high beam intensity and high spatial coherence leading to visualize sample phases with very small differences in the mass density. Combining the features of the SYRMEP beamline and of the cone-beam TOMOLAB station available at Elettra, we have the potential to image samples with different sizes and at variable spatial resolution and to increase the visibility of the structures by means of phase-contrast imaging techniques.

Moreover, new approaches related to the analysis of samples of large dimensions have been developed when high spatial resolution are required on small internal volumes of the samples. The application of local area techniques and the use of novel detectors will be described.

Contributions of Electron Microscopy and Microanalysis to Archaeological Research

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Here I present a brief survey of electron microscopy-based techniques used to image and analyse archaeological materials. I will focus mainly on the types of equipment available at the Electron Microscope Unit at the University of New South Wales. Electron microscopy is already used to investigate issues such as artefact provenance, trade and exchange, natural resource exploitation, raw materials and manufacturing techniques, artefact degradation and conservation techniques. In addition to touching on existing methodologies, I will highlight the major benefits of various EM-based techniques that give them the potential to be used to further archaeological research in new and innovative ways.

Archaeometallurgy at large scale facilities: new tools for old metals

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Modern imaging and characterization techniques at synchrotron and neutron facilities allows considerable extension of traditional archaeometallurgical investigations. X-ray and neutron radiography and tomography offer excellent diagnostic capabilities (Fig. 1), and when combined with diffraction and spectroscopy techniques they offer a powerful combination for the comprehensive characterization of metal objects.

Crystallographic texture analysis has also been proposed as a non-invasive tool for the reconstruction of 3-D metal textures, in place of invasive 2-D metallographic techniques. Examples of application to ancient copper and bronze objects will be presented.

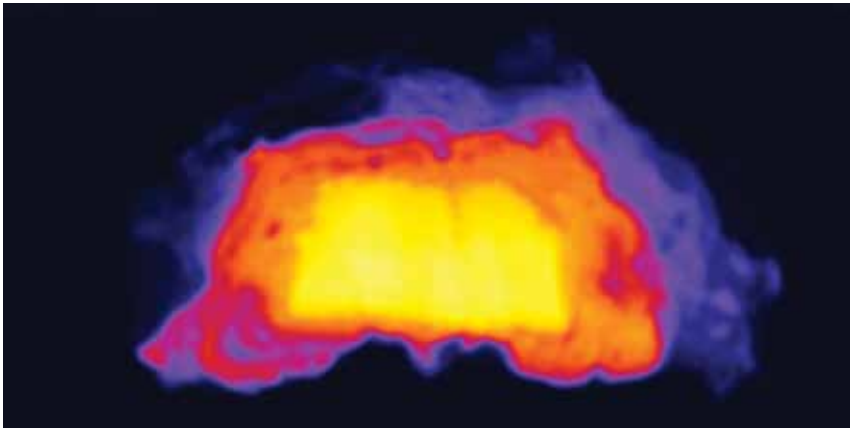

Figure 1
Virtual tomographic section of a Bronze Age copper ingot showing in false colors: the surface alteration layer of secondary copper carbonates and silicates, the intermediate cuprite layer, and the pristine copper core.

Faunal biogeography in Southeast Asia: implications for hominin dispersals

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Between the Southeast Asian mainland (Sunda) and Greater Australia (Sahul) there are ~25,000 islands. These islands vary greatly in colonisation difficulty depending on length of required water crossings, ocean currents and winds, as well as island size, age and geological history. All these factors have consequences for the differential distribution of plants and animals across the world's most geographically fragmented region. In fact, the natural distributions of terrestrial animals across island Southeast Asia provide an objective measure of the dispersal abilities for different species, the differential difficulty in colonising specific islands, and the factors facilitating or obstructing faunal colonisations.

This paper focuses on the biogeogaphic context for current and planned field projects in Indonesia It will summarise past and present distributions of terrestrial animal species on islands from Sunda to Sahul, as known from extant distributions; the palaeontological, archaeological, linguistic and historical records; and DNA evidence.

It concludes that differences between the distributions of hominins at different evolutionary and cultural stages (e.g. *Homo floresiensis*, *H. erectus*, early modern human, Neolithic farmers) and other large Asian animals provide a measure of changes in hominin technological prowess, while 'introduced' species provide evidence for human movements and contacts. Both lines of evidence can be used to predicatively model the colonisation sequence and identify islands or sites of high faunal, palaeontological archaeological research potential.

In search for the *Homo floresiensis* ancestors: excavating Pleistocene sites on the islands Flores and Sulawesi, Indonesia

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Since the discovery of a new species on the human family tree, the diminutive *Homo floresiensis*, on the Indonesian island of Flores, the debate on its place in human evolution has been ongoing. Detailed anatomical analysis of various aspects of LB1 have revealed a mosaic of advanced and primitive traits that suggest that *Homo floresiensis* may have been derived from an even earlier population than represented by the oldest known non-African hominin population, the 1.8 million year old hominins from Dmanisi in Georgia. On the other hand, the effects of island dwarfing are too little known to exclude the possibility that *Homo floresiensis* represents a dwarfed form of Homo erectus, of which numerous Early to Late Pleistocene fossil remains have been found on Java.

In order to address these questions our team is currently excavating Pleistocene sites on various Indonesian islands, with the principal aim to search for fossil hominin remains that could shed light on the ancestry of *H. floresiensis*. In the Soa Basin on Flores, where Early Pleistocene fluvio-lacustrine and volcanic deposits are eroding, 1 million year old stone artefacts have been excavated, proxy evidence for the presence of a pre-modern hominin, the putative hobbit ancestor. Our excavations in South Sulawesi also have yielded evidence that Pleistocene hominins were present at an early stage on this island, which may have served as a stepping stone to reach Flores. An overview of the current excavations and preliminary results on associated fossil fauna and stone artefacts will be given during this presentation.

Genetic heritage: from the living present to the past in Australia

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The genomes of living organisms provide powerful evidence of past populations because of the remarkable heritability of DNA. Genetic signatures of the past now take their place along with other forms of data to contribute to ancient heritage value for peoples whose identity has been eroded by recent history. Over the last three decades, improvements in DNA technology have accelerated the pace by which databases accumulate, fuelling debate about how recently modern humans spread throughout the world and whether or not they replaced earlier forms of *Homo* in Eurasia.

Australia's First Peoples left descendants whose genetic signatures are distinctive despite the loss of lineages that would have occurred over time through stochastic processes, conflict, disease and adverse natural catastrophes. The ancient heritage value of the Darling River and Willandra region, already established by archaeological, linguistic and anthropological evidence, is enhanced by genetic signatures from living people.

DNA studies from other representative descendants of Australia's rich and diverse language groups would give clues to likely dispersal processes within Australia as well as into Sahul. Complete genome sequencing is now technically possible, but interpretations have to remain cautious until the processes that generate diversity within species and how that diversity interacts with environmental factors to influence the functional expression of genes, is better understood.

Pushing the Radiocarbon limit in Australian archaeology

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For many years, the oldest radiocarbon dates for human occupation of Australia were stubbornly stuck at ~40 ka, although other methods were indicating greater antiquity. This suggested that the 40 ka barrier was a limitation of the radiocarbon method rather than a true indicator of the duration of human occupation. In particular, the issue of contamination of the sample by more recent carbon, either *in situ* or during sample preparation, could not be ruled out.

Consequently, several years ago we developed more stringent sample preparation methodologies at the ANU[1], which combined with the extremely low backgrounds possible with the ANU's 15 MV accelerator, have allowed us to go considerably beyond 40 ka[2]. Laboratories elsewhere have now adopted similar techniques. In this talk, I will provide an update, outline the principles of the technique, discuss its range of applicability and its limitations, and give some examples in Australian archaeology.

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Imaging Paintings with Synchrotron Radiation

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Understanding the structural and chemical composition of paintings and other artworks provides important information about their origins, painting technique and attribution. This information is central to guiding decisions relating to treatment and conservation strategies. Traditional transmission X-radiography has been extremely valuable as a non-destructive, non-invasive technique that provides spatially relevant compositional detail. However it lacks the ability to differentiate between heavy metal pigments, and over-paint with heavy X-ray absorbers can obscure underlying images.

New developments in detector speed in combination with the use of Synchrotron radiation have meant that collection of high resolution elemental distribution images in reasonable time frames is now possible. A number of test paintings have been used to develop an imaging strategy that is now used to examine larger artworks. This work has revealed the underlying composition below a self-portrait of Arthur Streeton that has been over-painted with lead white paint and has significant potential for the study of further artworks into the future.

Advanced X-Ray Imaging Techniques for Cultural Studies

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X-ray imaging is more than 100 years old and has become a vital tool in science, industry and medicine. Two major developments that have contributed very substantially to increasing the range and extent of information that can be obtained about materials using X-ray imaging, are:

i) X-ray microtomography that can yield quantitative 3D information on structure down to the sub-100nm scale [1].

ii) The development of X-ray phase-contrast techniques that can help to visualize weakly absorbing and minute features in materials, especially where these involve light elements [2,3].

In the present talk I will give a brief overview of some of the exciting developments that have occurred in the use of X-ray imaging for cultural heritage studies, and especially in the context of paleontology [4, 5]

I will also briefly outline the current state of the Imaging and Medical beamline at the Australian Synchrotron which will be one of the most advanced X-ray imaging facilities in the world and will provide an exciting new resource for imaging cultural heritage artifacts with high sensitivity to subtle variations in density and composition, including for quite wide samples [6]. This beamline is currently undergoing a major upgrade since it saw “first light” in December 2008 and is now around a $30M project, including advanced computational infrastructure for 3D imaging and visualization.

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Paleogenetics: a powerful tool for biological cultural heritage

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In the past two decades, ancient DNA research has progressed from the retrieval of small fragments of mitochondrial DNA from a few late Holocene specimens, to large-scale studies of ancient populations) phenotypically important nuclear loci, and even whole mitochondrial nuclear genome sequences of extinct species. An improved understanding of these processes and the effects of damage on ancient DNA templates has started to provide a more robust basis for research.

Increasingly, ancient genetic information is providing a unique means to empirically test assumptions used in evolutionary and population genetics studies about the genomes of past individuals and populations. Initial results have revealed surprisingly complex population histories, and indicate that modern phylogeographic studies may give misleading impressions about even the recent evolutionary past. With the advent and uptake of appropriate methodologies (i.e NGS: New Generations Sequencing), ancient DNA is now positioned to become a powerful tool in biological research and is also evolving new and unexpected uses as the field of biological cultural heritage.

However, the field is still regularly marred by erroneous reports, which underestimate the extent of contamination within laboratories and of the samples themselves. Undetected contamination is without doubt a serious problem especially in ancient human DNA study. However, the fact that such contamination does occurs does not imply that it cannot be recognized.

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