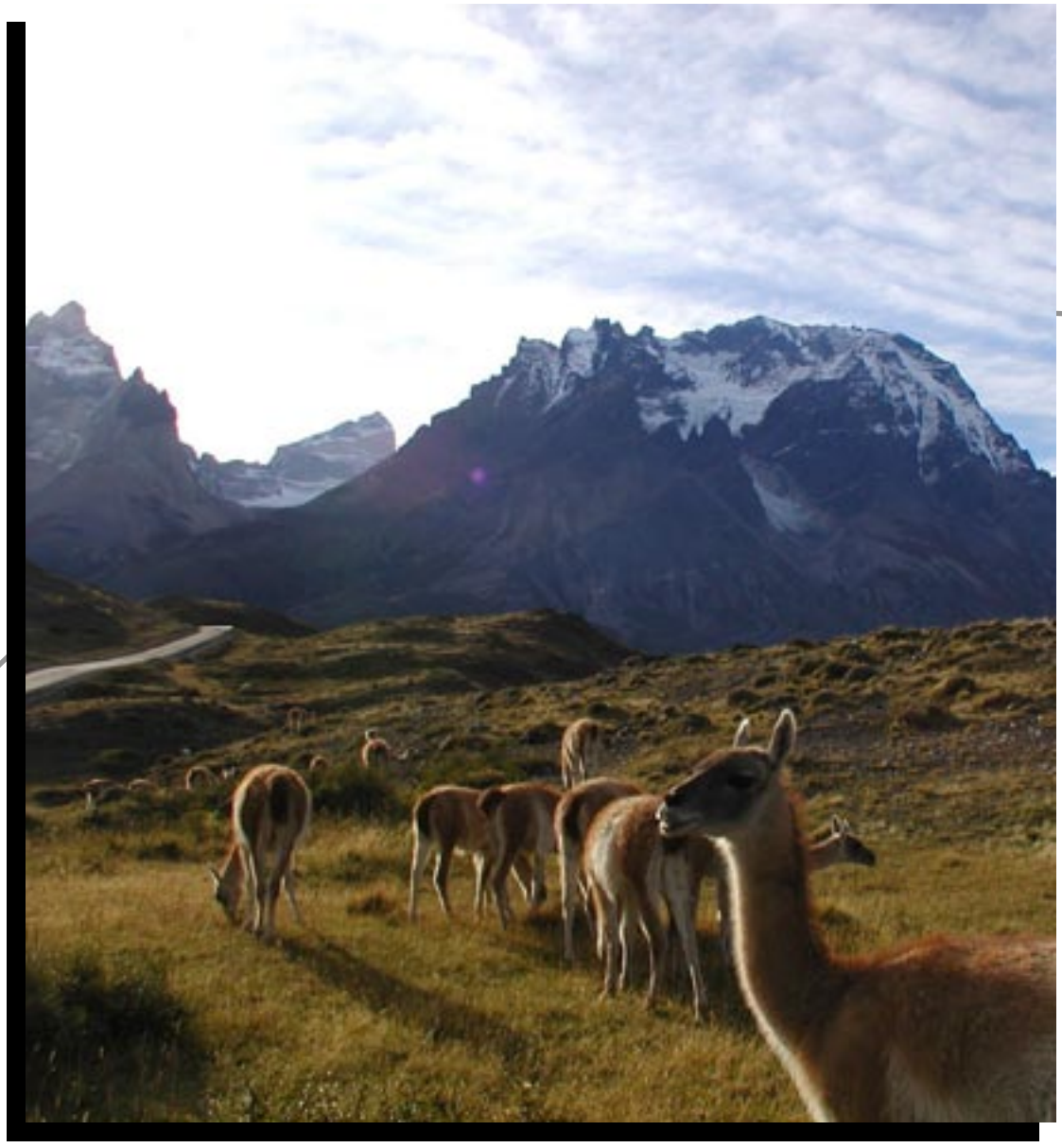
QUATERNARY AUSTRALASIA



Charismatic vertebrates living and dead...

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Front cover photo

A herd of Guanacos grazing on the ubiquitous moraines that dominate the Torres del Paine area. See report p24. (Photo: B. Alloway)

Back cover photo

Gilbert Price holding a vertebra of a *Diprotodon* from one of his sites on the Darling Downs. See report p15. (Photo: Tony Moore)

View north-west from Puerto Natales on the picturesque shores of Seno Ultima Esperanza (Last Hope Sound) - the southern terminus of the ferry trip through the Chilean fjords. (Photo: B. Alloway)

EDITORIAL

This issue of *QA* includes an unusual amount of Quaternary News (or, at least, what passes for it) including reports about the launch of the University of the Sea (Patrick DeDeckker), about Eric Colhoun's AQUA life membership (Stuart Pearson), about the recent Science meets Parliament (by Macquarie University doctoral student Tim Ralph) and about Peter Kershaw's 60th birthday bash. The issue includes reports of ongoing research being conducted by two university departments (Southern Cross and Newcastle), by a multidisciplinary, ANU-based team examining the archaeo-palaeo record of the Galapagos (presented by ANU doctoral student Iona Flett), and by doctoral student Gilbert Price (Queensland University of Technology) examining the fossil vertebrate record of the Darling Downs. In addition, Australasian Quaternarists have been active participants in conferences and field trips across a large swath of the southern hemisphere, judging by six reports of meetings in settings ranging from South Australia to New Zealand to Chilean Patagonia. A series of charismatic, large vertebrates weave through this issue, grazing on Chilean moraines when alive, being cradled in Gilbert Price's hands when very dead (on the front and back covers, respectively). Elsewhere, very large tortoises sneak up on Henk Heijnis at one end of South America, while very large sloths leave their millennia-old poo on the floors of Patagonian caves at the other end. In Australia, the causes of megafauna extinction continue to provide the focus of an intense debate, as reported by Esmée Webb (Edith Cowan University) from the CAVEPS conference at Naracoorte, and to which Stephen Wroe's (University of Sydney) guest editorial, and Gilbert Price's ongoing description and analysis of Late Pleistocene Darling Downs vertebrates, represent new contributions.

Kale Sniderman

Editor

PRESIDENT'S PEN

Santa Cruz, Galápagos 12 June 2005

It almost seem like an AQUA executive junket, this trip to the Galápagos with your ex-president Simon Haberle and myself as the recently elected AQUA president, but it is all part of the ARC-Discovery funded project on Stepping Stones or Barriers.

But first let me go back to December 2004, Cradle Mountain and the AQUA Bi-Annual Meeting. This meeting was very well attended (from both sides of the Tasman) and very well organised by Simon Haberle and Janelle Stevenson.

After three years as secretary, I was elected president of AQUA, which is a great honour and also very challenging with the INQUA Conference only 2 years away. At present, work is underway to finalise committees through the Australian Academy of Sciences - National Committee for Quaternary Research, under the leadership of Professor John Chappell.

For those members I haven't met, I came to Australia, in 1993, to work for the Australian Nuclear Science and Technology Organisation as a radiochemist and Quaternary Geologist. I was trained in both disciplines, in the Netherlands, firstly at the Free University (Quaternary Geology & Sea-level change) and during my PhD in Groningen at the Radiocarbon Laboratory (which is currently 51 years old).

Now back to the current fieldwork, this natural Disney World for Darwinians is suprisingly understudied when it comes to our discipline. The last time someone look at a pollen record from one of the many craters on Santa Cruz, was Colinvaux in the 1970s. This is now rapidly changing; within

PRESIDENT'S PEN

the last six months three international groups have visited the Island to take samples (all with slightly different research foci).

Our current effort includes palaeoecology and archeology. The archeologists, under the leadership of Professor Athol Anderson, are tracing the footsteps of the famous Thor Heyerdahl (of Kontiki fame, not the expensive travel agency) to see if there are indeed pre-European artefacts in the coastal deposits. Is this the place where Amerindians and Pacific Islanders met?

The palaeogroup is toughing it out in craters that have filled up with sediment, and sampling up to five metres of organics and lake clays.

The plan is to see how climate variability and human impact (e.g. the introduction of weeds) have affected this sensitive ecosystem.

So far we have collected some 50 metres of sediment sausage (as the archeologists call it), but surely we have to come back next year to finish it off.

As for AQUA business for the remainder of the year, we are now in a much better financial position than last year, thanks to an enthusiastic annual general meeting that voted for a membership fee increase.

Issues that the AQUA executive committee wishes to address this year include the gender imbalance in our membership, and gaining new members from Universities that are not well represented.

Until next time from a more mundane location,

best wishes

Henk Heijnis

QUATERNARY NEWS

Climate Change: Turning up the Heat
A. Barrie Pittock

CSIRO Publishing, 328 pages, 230 x 155 mm
Paperback - ISBN: 0643069313 - AU $39.95

In this book to be published in September, 2005, AQUA member Barrie Pittock, who lead the CSIRO Climate Impact Group in the 1990s, looks at the controversy around global warming and other predicted changes, examining the scientific basis of the changes observed to date, how they relate to natural variations and why the evidence points to larger changes later this century. The book discusses the palaeoclimatic evidence for (particularly rapid) climate change.

Winner of AQUA prize

The recipient of this year's AQUA Postgraduate Travel Prize is Kira Westaway, School of Earth Sciences, University of Wollongong. Kira will be attending the 11th International Conference on Luminesence and Electron Spin Resonance Dating to be held in Cologne, Germany, from the 24th - 29th July 2005 where she is presenting a paper and a poster. These are titled respectively "Dabbling with DAP: methodological advances in luminesence dating of archaeological sediments and palaeoenvironmental proxies in Indonesia using a dual-aliquot regenerative dose protocol", and "The application of a dual aliquot regenerative-dose protocol to important archaeological sediments and palaeoenvironmental proxies in Indonesia".

www.paleoclimate.org.nz

The NZ-INTIMATE co-ordinating group (Brent Alloway, Jamie Shulmeister, Rewi Newnham and David Barrell), are pleased to advise that the website is now online.

The site has been set up on behalf of all NZ (and adjacent region) palaeoclimate researchers, with the aim of providing interested people throughout the world with an easy access point for information and people to contact regarding palaeoclimate science and research.

University of the sea prepares to launch

The French vessel Marion Dufresne will be partly converted into an Australian-led University of the Sea for a historic research voyage this month, conducting research and teaching activities. The research ship's facilities will enable students to receive an intensive grounding in marine research during the two-week trip from Port Moresby to Darwin. Patrick De Deckker will lead a team of three academics and 19 postgraduate students [7 Australians and 11 from the Asia-Pacific region]. Patrick and colleagues from the University of Sydney and University of Technology, Sydney, attracted support from a variety of sources to conduct this first voyage.

While at sea, researchers and technicians will primarily take long (>40m) cores as well as box cores (again >12m long). Those cores will be opened, logged, photographed, and various physicochemical properties will be measured before storing the cores at 4°C. Some cores will be sampled for geochemical analysis, including organic compounds.

All UOS students are to participate in the above tasks by helping the researchers and technicians. Principal coring areas will be in the Gulf of Papua, the Arafura Sea, and possibly Bonaparte Gulf or south of the Timor Trough. Students will also participate in plankton sampling, examination and use the CTD (conductivity-temperature-depth) water sampling equipment, and interpretation of the data. In some areas, swath mapping will also be carried out, including the use and interpretation of 3.5Kh seismic profiles. Lectures will be presented every day to the students by UOS staff, including Ass. Prof. Jock Keene from Sydney University, as well as by other researchers, plus ship staff.

Principal lecture themes are:

Principles of navigation; swath mapping techniques and their interpretation; seismic profiling and relevant interpretation.; coring techniques (gravity, Kuhlenberg, giant box corer); plankton and benthos collection (plus practical examination under microscopes); core logging and interpretation of all physico-chemical properties; water sampling and water chemistry. Additional lectures will be presented on sedimentology, isotope and trace element geochemistry, oceanic carbon cycling, micropalaeontology, and satellite imagery of relevance to oceanography.

Students will be asked to submit a report of all activities before leaving the ship, plus will have to prepare and present a poster detailing one specific research activity of their choice. Students will be asked to work in groups that will enable people with diversified interests to work together. Poster presentation to the UOS group will occur towards the end of the cruise with a prize ceremony following afterwards.

For more information, contact Patrick De Deckker, cruise leader for the UOS in 2005.
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The voyage can be followed online at:
http://uos.anu.edu.au

Hopefully, this 'venture' will be repeated in 2006 when the Marion Dufresne will be visiting Australian waters once more.

Science Meets Parliament

National Press Club and Parliament House Canberra, March 8-9 2005

Tim Ralph

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On the 8th and 9th of March 2005, the Federation of Australian Scientific and Technological Societies (FASTS) held its annual Science meets Parliament (SmP) event. The purpose of SmP is to provide a platform for the interaction of scientists and politicians, facilitating discussion and the exchange of ideas over key issues in science and technology, and in research- and electorate-specific areas of interest. Researchers are able to raise the profile of their science, increase current awareness and gain an insight into decision-making processes involving scientific issues at the national level.

Overall, 215 Australian scientists (including 32 post-graduate students) and 155 politicians attended formal meetings and associated functions over two days, making 2005 the largest SmP gathering to date. For a relatively small organisation, AQUA was

represented by a significant group, including Dr Henk Heijnis (ANSTO), Dr Janelle Stevenson (ANU), Ms Jennifer Harrison (ANSTO), and myself (Macq.U), as an AQUA-funded post-graduate representative.

The two day SmP program allowed time for scientists from all backgrounds to meet with each other before proceeding into their formal meetings with the Parliamentarians. The first day was used to inform scientists on strategic approaches to effective communication, Parliamentary processes, and other administrative issues. Briefing sessions were all held in the National Press Club, and the speakers included senior Parliamentarians, members of staff, bureaucrats, journalists and political lobbyists.

Overviews were given on four key issues for SmP 2005, which included: climate change, the National Water Initiative, research infrastructure, and productivity and balance of trade; all of which were hot topics for further discourse and debate. Other speakers provided an overview of what both scientists and Parliamentarians may expect and how to maximise the outcomes of our meetings, with an emphasis on establishing links beyond SmP.

The guest speaker at the National Press Club Lunch was the Hon. Dr Brendan Nelson (Minister for Education, Science and Training), who outlined the Government's fourth term science and technology agenda. A forum was also held to discuss issues relating to the drivers of public concern in science, including how and what the community think about new technologies, with some overview of associated moral considerations. The day culminated in a reception and dinner at Parliament House, with informal science-industry-government interactions and a guest speech from Dr Caroline Kovac (General Manager, IBM Healthcare and Life Sciences).

The second day began with an informal breakfast for early-career researchers and PhD students, along with selected Parliamentary advisors and researchers. For the rest of the day meetings were conducted with Parliamentarians at pre-appointed times – generally two meetings per scientist, each lasting for about 30 minutes unless the politician's interest was such to promote longer more detailed discussion. Where possible, scientists and politicians are matched for their meetings based on their mutual scientific interests, as well as the focal points of their research and their electoral interests respectively. This tended to provide for productive partnerships and reasonable approaches to time-sharing during the meetings. Incidentally, in one meeting I (a geomorphologist) was grouped with an entomologist and a geneticist, and we managed a collaborative discussion on issues surrounding irrigation, cotton, water use and landscapes in semi-arid NSW!

In between formal meetings there was an opportunity to participate in semi-formal forums dealing with four key issues in science today:

1. Mobility and flexibility in global science and technology labour (including skills shortages);

2. Science and education, with an address by Jenny Macklin (Shadow Minister for Education, Science and Training);

3. Climate change and scientific consensus, with implications for science, industry and policy;

4. A bio-medical hypothetical on the science, politics and institutional elements of a viral pandemic.

These broadly focussed sessions provided a starting point for more discussion and interaction between participants throughout the day.

I was impressed with SmP, which gave us, as AQUA representatives, the opportunity to gain first-hand experience of issues currently at the scientific/political interface, and to share and consider views with other scientists and politicians on a wide range of topics. In particular, I felt that we were able to actively contribute to current awareness about the relevance of Quaternary science to contemporary and future decision-making, with an emphasis on long-term biophysical issues which often influence modern environments on a time-scale appropriate for political consideration and management.

Building on my discussions with the advisors to the (then) Deputy Prime Minister, John Anderson, at SmP 2005, I was also recently able to meet with Mr Anderson – whose electorate encompasses the Macquarie Marshes in central western NSW (the site of my current PhD research of geomorphic processes and wetlands morphodynamics) – and the Chair of the National Water Commission, Ken Matthews. The purpose of the meeting was to brief them on our (Macquarie Uni.) geomorphic work in the Macquarie Marshes, and to provide an overview of the significance and complexity of the system. Following the briefing in the town of Warren on the 4th April, we also took a flight over the marshes, which allowed a better appreciation of the biophysical aspects of the floodplain wetland system, and some of the challenges facing environmental managers.

The financial assistance of AQUA for my attendance at SmP 2005 is gratefully acknowledged.

Professor Eric Colhoun's contribution to science acknowledged with AQUA life membership

Stuart Pearson

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Professor Eric Colhoun was inducted into life membership of the AQUA during a plenary session at the Dec 2004 Conference at Cradle Mountain. This privilege has previously only been awarded to one other person – Professor Jim Bowler. The award recognises a sustained and significant contribution to our understanding of the Quaternary Period. This acknowledgement of Professor Colhoun's outstanding contribution to the description and understanding of past glacial and cool temperate ecosystems comes as he enters productive retirement. His geographical research in Ireland and Tasmania has been internationally recognised and at the December 2004 meeting of AQUA, his colleagues and former students explained the way he had nurtured their scientific growth. Although there were primordial stirrings in the late 1960s and 1970s amongst Jim Bowler, Jeanette Hope, Bruce Thom and other scientists to form some association, Eric catalysed the Australasian Association and launched its field-based approach.

It all happened one night during the Birmingham INQUA Congress in 1976 when Jim Bowler, David Hopley, Guus van de Geer and Eric were having a drink. Eric said "I suggested to Jim that we really needed an organization in OZ to promote Quaternary Science." They agreed. Eric suggested a model like the UK's Quaternary Research Association. Its aim was to have annual field meetings to study the evidence of Quaternary environments of different regions. Eric had been a member since 1964, the year after it was founded, well after the United States' Friends of the Pleistocene which has its origins in the 19th century.

Eric recalled, "having spoken up, I agreed to run a field trip in Tasmania in 1979 which was attended by about 16 persons including such notables as Bob Galloway (a very strong supporter of AQUA in early days) Patrick De Deckker, Gurdip Singh, Rhys Jones, Sandra Bowdler, Geoff Hope and Jeanette Hope. We got wonderful weather and it was a roaring success."

Eric Colhoun at Hamilton End Moraine.
(Photo: Brent Alloway)

This initiative was lost in the sediment for some time and then in 1984 it was revived by Jim Bowler. With some controversy the Association was formally founded at Macquarie University amongst what Eric recalls as "Quaternary euphoria".

The founding vision was to promote field experience of Quaternary sites and the development of young Quaternary Scientists. The Association and the Quaternary in Australia has benefited enormously from the big Irishman's contribution to both of these aims. The meeting at Cradle Mountain was an opportunity for the Association's members to recognise the contribution of Professor Eric Colhoun to the 25 years of progress since that first sortie with the Quaternary community to Tasmania. Eric lead the exhaustive pre-conference glacial geomorphology fieldtrip (photos below).

In 2007 Australia hosts the INQUA conference in Cairns and thousands of international delegates will converge to share Quaternary research. Eric Colhoun's hand will be seen in the strength of the Australasian contributions.

Pope Peter turns 60!

Kate Harle

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It was typical of Peter Kershaw that he chose to celebrate his 60th birthday with a seminar series and dressed as the pope. The notification of this auspicious event, which had a distinctly Rowan Atkinson meets Spanish Inquisition feel to it, invited the "Faithful" to attend a special Sporopollenin on 'The Value of Quaternary Studies to Current Environmental Issues' to be followed by an extravaganza of live entertainment, including a special appearance of the "Universal Pope". The Sporopollenin, held at Monash University's School of Geography and Environmental Science (and not in Kershaw's pool as some of us at first anticipated) proved to be an excellent workshop, with a series of papers presented by invited ex-Monash speakers. The party proved to be a highly enjoyable pseudo-reunion, attended by well over 60 people. The appearance of Pope Peter, dressed in full regalia, was a highlight, as was the presentation by "Arnie's Angels" of a special rendition of *Hark! The Herald Angels Sing*. This was the third appearance of the Angels, a gathering of women who have had the distinction of being supervised by Peter, their numbers swelled considerably since their previous two appearances, Peter's 40th and 50th. All-in-all it was a suitably spectacular celebration of one of Australia's Quaternary icons. Happy Birthday Peter

(Photos: Brian Carr)

The Arnie's Angels 60th Birthday Tribute

(To the tune of *Hark! The Herald Angels Sing*, words by Divine Inspiration)

Hark the Arnie's Angels singing
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
Pollen records, Lynch's Crater
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
Firestick farming at Stage 5e
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
He sees clear trends in this record
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
Coring every bog that he sees
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
Especially when he finds them
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
Students working whilst he's sleeping
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
He sees clear trends in this record
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
Sitting at our microscopes we're working
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
What is this pollen we see
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
He thinks that they're all legumes
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
He sees clear trends in this record
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
Lynch's Crater he keeps dating
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
Publications list he's inflating
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
Global trends that he's creating
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh
He sees precession in all records
Ooh Ooh Ooh Ooh Ooh Ooooooh Ooh Ooh

GUEST EDITORIAL

On little lizards and the big extinction blame game

Stephen Wroe

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In 1983 the distinguished ecologist Michael Soulé concluded that "Except for island cases, we know very little about the process of natural extinction". Despite some headway since, Soulé's conclusion may still largely hold true. No one doubts that humans are driving the current extinction crisis, but rarely is agreement achieved over precisely which human-mediated influences are responsible or how they interact. However, there is growing consensus in one area: recent extinctions can almost never be attributed to a single cause (Didham *et al.*, 2005).

With so many unknowns surrounding extinction in the present, what hope then of truly understanding extinctions in the deep past? Yet, despite the challenges, many continue to focus effort on the disappearance of prehistoric species, and in no area more so than the extinction of Late Quaternary megafauna. Perhaps this should not be surprising. Megafaunal extinction is characterised by charismatic, awe-inspiring creatures and offers other key ingredients: a tantalising potential role for our own species and insight into the current crisis. However, possible human involvement in this prehistoric drama also challenges our objectivity and undeniably inflames passions among scientists and laypersons alike. Historically, megafaunal extinction has been polarised into factions supporting *either* human *or* climate mediated causation. Those expressing doubt with respect to competing hypotheses within either category are likely to be labeled as supporters of the opposing camp - you're with us or against us. Those treating both factors as important contributors have often been marginalised as fence-sitters lacking the courage of their convictions. I consider myself one of these, but think that we fence-sitters represent a growing minority. Increasingly, the question is not whether humans or climate caused Late Quaternary extinctions of megafauna, but how these factors variably combined at different places and times. Indeed, if the invasive species under consideration was not *Homo sapiens*, either/or arguments might never have prevailed.

To illustrate this argument I refer to a study of localised extinction among Caribbean island lizard populations. In 2001, Schoener *et al.* found that a naturally invading predatory lizard (*Leiocephalus carinatus*) increased the risk of extinction for a smaller species (*Anolis sagrei*) in the wake of a major hurricane. Despite serious population crashes, *A. sagrei* invariably survived where the invasive predator was absent, but went locally extinct on most islands occupied by the new predator. The authors reported this as a rare empirical demonstration of interplay between climatic disturbance and predation, and left it at that. But was it the invading lizard or the hurricane that drove these local extinctions? A case could be made for either, but what would such a blame game achieve? Doubtless victory on the day would go to the most able sophist, but surely, if we truly want to understand what happened to little *A. sagrei*, we need to first accept that both played a role.

The blame game has long been a hallmark of the megafaunal extinction debate, with findings typically presented as strong support for human or climatic causation, a tendency aggravated by media that thrive on simplicity and conflict. Often the stated objective of research into megafaunal extinction is to gain insight into current human impacts. In reality there is more to it than this. Egos, funding and political agendas are at stake. Many archaeologists are sensitive to the fact that placing blame for prehistoric extinctions entirely on the ancestors of surviving indigenous people can fuel vilification. For others, accepting that *Homo sapiens*, including 'pristine' hunter-gatherer societies, were solely responsible for all Late Quaternary extinctions is a catharsis that must be faced if we're to move current conservation efforts forward (Grayson and Meltzer, 2003; Wroe *et al.*, 2004*a*). However, if we are going to make this issue relevant we need to pull away from polarised positions and unicausal explanations. At present no single mechanism adequately explains the disappearance of megafauna in the Late Quaternary.

With my position stated I'll attempt a very brief overview.

The current round of obsession with megafaunal extinction in Australia arguably began with the finding, based on direct dating of eggshells, that a large terrestrial bird (*Genyornis newtoni*) went extinct in the central-south of the continent at around 50 ka (Miller *et al.*, 1999). The authors extrapolated on this result, interpreting it as evidence for continent-wide extinction of *G. newtoni*, then further suggested that this approximated the timing for complete extinction of around 50 other species of megafauna. Shortly after, in a second influential publication, it was concluded that all Australian megafauna went extinct by around 46.5 ka, predating major climate change (Roberts *et al.*, 2001). This result was based on statistical analysis of seven megafauna-bearing sites in which sites younger than 46 ka were excluded *a. priori* following a selection process modified after Meltzer and Mead (1985). The findings of Roberts *et al.* were published concurrently with the results of computer simulation suggesting that human predation rapidly eliminated North American megafauna (Alroy, 2001).

Unsurprisingly, scientists hoping to bring closure to the debate hailed this body of evidence as proof-positive that megafaunal extinction in Australia (and North America) was an entirely human-mediated affair. However, outright acceptance rested on a good many assumptions.

Skeptics have argued that while evidence for localised extinction of *G. newtoni* supports the notion that things were certainly changing in south central Australia by 50 ka, the argument that this approximates the coincident continent-wide extinction of all megafauna amounts to second order speculation (Wroe *et al.*, 2004*a*). Regarding Roberts *et al.* (2001), now matter how you wash it, the evidence for a mass extinction event at 46.5 ka is based on a very small dataset. And, while it is arguably justified to apply selection criteria to megafauna-bearing sites for heuristic purposes, such procedures will never in themselves prove that dates from excluded sites were erroneous. The application of differing selection criteria will produce varied results. That chosen by Roberts *et al.* (2001), i.e., presence of articulated remains, was not among those originally suggested by Meltzer and Mead (1985), but if we applied one that was, such as 'strata capped above and below by pavement', then some Australian megafauna persisted until 30 ka. Alternatively, if we applied Roberts *et al.*'s criterion to the North American record then most American megafauna were extinct thousands of years before the arrival of Clovis people. Critically considered, results tendered by Miller *et al.* (1999) and Roberts *et al.* (2001) might constitute compelling evidence for localised extinctions and broad scale population reductions by 46 ka, but not for catastrophic mass extinction. For proponents of entirely human-mediated causation in Australia the problem is that as proposed dates for extinction more closely approach the onset of the LGM, it becomes increasingly difficult to decouple human and climate-mediated influences. However, from the limited data available, at 50 to 45 ka there is evidence for a shift to a glacial biome at Lynch's Crater in Queensland (Barnosky *et al.*, 2004, where cited as "Lynch's Lake") and previously unknown climatic instability Australia-wide from around 45 ka (Hope *et al.*, 2004). It has also recently been posited that full glacial conditions were in effect by 30 ka, much earlier than previously thought (Lambeck *et al.*, 2002). The presumption of Miller *et al.* (1999) is that changes at 50 to 45 ka were, in themselves, insufficient to cause mass extinction. May be, may be not, but certainly this ignores the above data, as does a more recent paper examining changes in emu diet from the same area (Miller *et al.*, 2005). Either way it is circular in that it assumes continent-wide mass extinction at 50-45 ka rather than population reductions and range contractions to levels at which fossilisation becomes rare. Increasingly arid conditions would not only have reduced the incidence of fossilisation, but as an erosional regime took the ascendancy younger deposits would have weathered away first. This is not evidence for climate as mediator, however, in a continent where megafauna-bearing sites of any age are extremely rare, is does give cause to consider any claimed extinction dates with skepticism.

The efficacy of computer simulations also rests on assumptions, whether offered in support or refutation of human-mediated extinction. It may be argued that such analyses put the horse before the cart in that none have yet modeled hunter-gatherer/megafauna dynamics in the only place it can currently be observed – Africa. Among assumptions inherent to algorithm-based models, the most obvious is that all extinct taxa were present when humans arrived (Wroe *et al.*, 2004*a*). Ultimately our confidence in results reflects our confidence in the use of existing faunas and hunter-gatherer societies as proxies. In the case of Australia in particular this is a big call. Even empirical underpinnings as fundamental as body mass remain largely founded in guesswork (Wroe *et al.*, 2004*b*). Algorithms typically assume that colonising humans could rapidly 'invade' all habitats and populate them at densities comparable to those of selected modern hunter-gather societies. How realistic is this? Despite debate over detail, most archaeologists agree that Aboriginal population densities and ranges increased significantly during the Holocene (Johnson and Wroe, 2003). Technological innovations accompanied these developments.

On little lizards

How much less pervasive or technologically sophisticated might founding societies at least 30,000 years more ancient have been? The straight answer is: we don't know. As recently reasserted by Macaulay *et al.* (2005), it is certainly possible that the seafaring first Australians hugged the coastline, requiring many millennia to develop the tools, local knowledge and skills-sets required to colonise the entire continent at densities approaching that of more recent Aboriginal societies. At present we can neither assume nor dismiss this view. Until we can, attempts to model the impact and rapidity of human colonisation should allow for the full gamut of possibilities.

Critical to almost all models that support human causation is a prominent role for prey 'naivety'. Because they lacked human-specific anti-predator responses, naïve species fell easy prey to human colonisers. Analogy is drawn with remote island taxa that are indeed pathetically vulnerable to human predation. However, this analogy is misleading. Most oceanic island species have had no terrestrial predators of any kind for geologically significant periods and are incredibly vulnerable to any invading species. No human-specific anti-predator responses have yet been identified in extant taxa. Living megafauna respond to human predators in the same way that they respond to other predators (fight or flight) and, unlike remote island species, continental taxa demonstrably learn to transfer generalised anti-predator responses to novel predators (Blumstien and Daniel, 2003). Nonetheless, there is likely some truth in the concept of naivety. Any student of Australian ecology understands that invading predators can have an edge over endemic prey (although it has yet to be demonstrated that predation alone has caused a single extinction). The reality is that on continents, human-naïve species probably were initially more vulnerable to human predation than Afro-Eurasian taxa, but far less so than oceanic island species. How much more vulnerable, or how long it would have taken for them to recognise humans as predators is again unknown. Models that support predation-driven extinction on continents either assume that naivety was total, or that it was a constant. Neither assumption is realistic.

The flipside of naivety is hunting efficiency. Human intelligence and technology sets us apart. Obviously the first Australians were as intelligent as their descendents, but it is equally certain that their knowledge and tool-kits were not as finely tuned to local conditions nor as sophisticated. Specialised tools associated with big-game hunting elsewhere, such as stone projectile tips and spear-throwers are unknown until post-Last Glacial Maximum (LGM). This doesn't mean that big-game wasn't hunted, but it does mean they were probably hunted less efficiently. An absence of other tools (e.g., seed-grinders) and knowledge required to expand the plant and small-game resource base may have further constrained population sizes and ranges, limiting human impacts on megafauna.

While models supporting wholly human-driven extinction have their problems, the same can certainly be said of climate-mediated scenarios. I will spend less time considering climate for the simple reason that far less energy has been devoted to demonstrating a role for it. For those convinced that climate was key, explaining precisely how climate alone could have produced extinctions on the scale recorded remains elusive. Another obvious problem is a failure to quantitatively demonstrate why previous Glacial Maxima did not cause mass extinctions comparable to those associated with the LGM. As measured by proxies for sea level, the LGM was certainly one of the Pleistocene's more intense maxima, but not the worst. However, at local levels we have much to learn about the effects of the LGM and even more to learn about previous Maxima. Until we know more we cannot be sure that we are comparing apples to apples. In Australia, mounting evidence suggests that local effects of the LGM were indeed more severe that that of previous Maxima (Nanson *et al.*, 1992) and that vegetation patterns of the Late Quaternary are the result of unprecedented climate driven trends beginning around 300,000 years ago (Kershaw *et al.*, 2003; Hope *et al.*, 2004).

Since 2001 there have been further significant developments. A number of recent studies have been presented as support for human causation in Australia and elsewhere (e.g., Brook and Bowman 2004; Burney *et al.*, 2004; Miller *et al.*, 2005), but most point to multicausal explanations. Other findings have supported climate-driven or at least not exclusively human-mediated scenarios. These can be roughly divided into those that present evidence for localised extinction or population decline predating human arrival (e.g., Shapiro *et al.*, 2004; Price and Sobbe, 2005) and those that present evidence for late survival of megafauna (Stuart *et al.*, 2004; Trueman *et al.*, 2005). Of course, a lack of evidence for a human presence in specific locales will never entirely preclude the possibility that humans were there,

nor that humans may have dealt a *coup de grâce* to remnant populations elsewhere. Moreover, evidence for late survival is not in itself an argument against a significant human role.

What I find encouraging is that, viewed as a global event, most of this recent research shies away from the promotion of simplistic unicausal mechanisms. The most recent major review accepts some role for climate alongside various human-mediated impacts (Barnosky *et al.*, 2004). Similarly, the best-supported scenario produced by recent computer modeling suggested a significant role for habitat change (climate and/or human induced), as well as predation (Brook and Bowman, 2004). In modeling a multicausal process this represented a very significant and innovative advance over most previous simulations. However, despite this, the authors present their results as evidence for a human driven process. Similarly, on the other hand, Shapiro *et al.* (2004) interpret demonstration of protracted decline in North American bison populations predating human arrival as evidence for climate-mediated extinction, i.e., humans simply finished off already vulnerable populations. I would argue that both studies evidence complex processes in which humans and climate played a role. Back to our little lizard: was it the hurricane or the invader? Increasingly I believe that this will come to be seen as a largely futile and loaded question that can only serve to stifle the science. If we want to understand megafaunal extinction and contribute constructively to management of the present day crisis, perhaps we should leave the blame game to journalists and politicians.

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On little lizards

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Simon Haberle and Henk Heijnis in the Galápagos

A Dictionary of Geomorphic Archaeology

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This dictionary is being cooked up by geomorphologist, Bob Haworth, and archaeologist, Rosalind James, so that they can each understand what the other is talking about on field trips. They also hope it will be of use to other Quaternary studies practitioners delving into cognate disciplines, but it is being written specifically for archaeology students at University of New England and elsewhere.

After the merger seven years ago of geomorphology and archaeology at UNE, both disciplines began a happy and fruitful co-operation, leading to some world-class discoveries (including the "Hobbit"). But there were language difficulties. Archaeology began a century or more ago as a rather genteel humanities pursuit and for a long time neither had nor wanted any connection with 'hard science'. Times changed: the rise of 'Quaternarism' demonstrated that the human past had to be put into its environmental, taphonomic, geomorphic, climatic context, etc. Whilst wishing to incorporate these aspects into courses, it was difficult at that time to find an accessible synthesis to use as a text and especially one targeted at Australian conditions. Hence, this dictionary and, hence, the reproduction here of a typical entry, on 'mounds', landforms very much open to misinterpretation. With a fair bit of help from such connections as AINSE and our own science departments, UNE Archaeology now tries to show students how all discoveries must be set in their environmental as well as their cultural context. This includes considering how sites and their deposits may have been altered by weathering and erosion or other the taphonomic processes, as well as the past climates and landforms that may also have influenced human behaviour. As a matter of course, good geomorphology can help predict the location of sites, as well as winnow out the false leads. We hope to have the book published sometime next year.

Mounds

mound (1) A low hill of earth, natural or artificial: in general, any prominent, more or less isolated hill. (2) A heap of earth

The world is full of mounds. Some are natural, some artificial, some a mixture of the two. It is their isolation that is unusual, for this suggests, but does not absolutely demonstrate, a depositional origin (that is, someone, some thing, or some process dumped it there). Archaeologists get excited at the discovery of a mound, as isolated heaps of earth may indicate human agency. Geomorphologists are party poopers: part of their job is to be devil's advocate and test for non-human agency. But it may save you the embarrassment of a Piltdown or a Jinmium.

Let us examine the alternative non-cultural hypotheses that may explain the presence of your mound. Of course, whether natural or artificial, your mound may still have been used by humans. Depending on its setting, a heap of earth all on its own may have lots of attractions as a camping site or vantage point.

1st question: is it depositional or erosional? Has the material been transported from somewhere else or is it a relic of some once bigger, probably bedrock, landform which has been wasted by time to a relatively insignificant hump?

The obvious way to test this is to dig and see if it is soil-covered residual bedrock or deposited layers of soft sediment. But you may need permission to dig. And anyway, save your energy by falling back on the first rule: *have a good look around.*

Observe its relation to surrounding landforms. Start from a distance of some km and move in along a concentric circle (a dingo trick common to all natural predators) and thoroughly absorb the lie of the land. Particularly watch out for repetitions and patterns, especially if they also produce mounds. Is your mound conformable with the landscape, a variation on other patterns, an isolated but related extension of something, or one of a kind? Even if there is more than one, are they separate from the lay of the land or in harmony with the geomorphic songlines?

Mounds

Does it look like a residual bit of ridge that erosion has advanced around and cut off from the main body? Is there more than one mound? What land unit is it set on? Slope? Flat? Hillcrest? Most importantly, as you approach it, what appears to be immediately underneath your mound, and around its sides? Conformable earth? Or a sharp break from one material to another?

Scratch a little at the mound's base. There will almost certainly be a little slope-washed material at the base (colluvium) whatever the mound's origin. Behind this, check if there is continuity of material between the surrounds and the mound. If you are still unable to dig, core or auger, check for ant nests or rabbit burrows on the mound, or any other non-human underground sampler.

If a naturally formed mound is in a flat swampy area, humans will prefer to camp or live on it. This may be confusing: human artefacts may work into a natural feature.

If there are a lot of mounds in an area, or if you want to compare them to mounds elsewhere, a good non-invasive method is to draw cross sections and contour plans with uniform scales. Having done this, attempt to work out the erosion history of each mound, if any, and what may be local erosive agents. Then assess what all the mounds have in common, and what they have that makes them different.

In foreground (in front of me) is a truncated clay lunette at Little Llangothlin Lagoon, Guyra, NSW. Charcoal from the base of this mound has been carbon-dated to before 14 ka BP, whereas the sand lunette in the distance, marked by a line of trees, apparently formed after 10 ka BP. The clay lunette is devoid of Aboriginal artifacts, whereas they are common in the sand lunette. Both 'mounds' look the same from the surface, but their orientation, composition and contents are quite different.

Pleistocene megafauna extinction: new evidence from the Darling Downs, southeastern Queensland

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Debate concerning the extinction of the Australian Pleistocene megafauna has become polarised in recent years. Several proponents favour either climatic or anthropogenic megafauna extinction models. Critical to the debate is the development of accurate chronologies of initial human occupation and megafauna extinction. However, current imprecise and/or lacking chronologies are a contributing factor to the failure to resolve arguments about the causes of megafaunal extinctions. Additional deposits incorporating more complex and detailed ecological analyses and dating at different regional scales are required to resolve issues relating to megafauna extinction.

The Darling Downs, southeastern Queensland has enormous potential to help answer questions relating to megafauna extinction. The Darling Downs is particularly fossil-rich, with over 50 known megafauna-bearing fossil deposits in a small (16 000 km^2) geographic area (Molnar and Kurz, 1997). Perhaps most importantly, the deposits may encompass the megafauna extinction episode in eastern Australia (Roberts *et al.*, 2001). Previous palaeoenvironmental interpretations were primarily based on megafauna species occurring in the deposits and are suggestive of expansive grasslands with some woodlands (Molnar and Kurz, 1997). However, such interpretations are limited as few studies have addressed the documentation of detailed stratigraphic, sedimentologic and taphonomic aspects of the deposits. Additionally, past fossil collecting was biased towards the recovery of large-sized megafauna taxa. Small-sized forms are poorly known, thereby limiting previous palaeoenvironmental interpretations.

Recent studies of fossil deposits in the Kings Creek catchment, southern Darling Downs were aimed at incorporating detailed aspects of dating, stratigraphy, taphonomy and palaeoecology to establish a more accurate interpretation of the Pleistocene environment (Price, 2002, 2004; Price *et al.*, 2005; Price andHocknull, 2005; Price and Sobbe, 2005). The Kings Creek catchment provides a unique opportunity to examine detailed palaeoecological aspects of a Pleistocene floodplain community in a small geographic area. Fossil accumulations within floodplains are typically transported, and it is commonly difficult or impossible to reliably constrain the sampling area of palaeodrainages. However, regional topography can be used to constrain the size of the Pleistocene Kings Creek catchment using the size of the modern catchment as an analogy. The Pleistocene catchment was relatively small, suggesting that fossil material could not have been transported over distances greater than 20-25 km. Thus, palaeoecological implications represent a small, well-constrained geographic area. Additionally, stratigraphic excavation techniques have allowed recovery of large collections of vertebrate remains that represent temporal sequences.

Radiocarbon dating indicates that the deposits are late Pleistocene (45-40 ka). Depositional processes in the catchment include both high-energy channel and low-energy vertical accretion deposits. Such depositional processes have a range of taphonomic signatures for both large- and small-sized vertebrates occurring in the deposits. Several biases have been observed relating to the differential preservation of mammals versus non-mammal vertebrates. Such biases may be related to fluvial sorting and/or density dependent destruction of different skeletal elements or taxa. Generally, identifiable material appears to have been derived from the surrounding proximal floodplain, an interpretation that is consistent with the geographically small Pleistocene catchment.

Systematic collecting methods targeted the recovery of invertebrates and both large- and small-sized vertebrates. Over 50 species were recovered from the deposits, including typical megafauna taxa (e.g. *Megalania*, *Diprotodon*, *Protemnodon* spp.) as well as new records of entire groups, such as land snails, frogs, skinks, and bandicoots. Most of the new records include extant species, and Pleistocene geographic

range extensions have been documented for several of those taxa. Such assemblages suggest that the late Pleistocene Darling Downs climate was more equable than present, with more available water throughout the year.

Habitat interpretations based on the observed and inferred ecologies of Pleistocene Darling Downs taxa have increased the precision of previous palaeoenvironmental interpretations. A mosaic of habitats occurred on the Pleistocene floodplain including vine thickets, scrublands, open sclerophyllous woodlands interspersed with sparse grassy understories and open grasslands. However, at the time of initial European colonisation, open grasslands dominated the floodplain with woodlands confined closer to hillsides (Fensham and Fairfax, 1997). That suggests that significant habitat changes occurred since the late Pleistocene. Thus far, there is no specific evidence supporting an anthropogenic role in the contraction of late Pleistocene Darling Downs habitats or megafauna extinctions for several reasons. 1) There is no evidence of humans in the megafauna deposits (i.e. there are no cultural artefacts or human remains). 2) The charcoal record is poor suggesting that natural or anthropogenic firing of the Pleistocene landscape was insignificant. 3) Cut-markings on bones relate to feeding by non-human carnivores. 4) The megafauna deposits are 30-35 ka older than the first record of humans in the region. Other ecological and sedimentological data suggest that significant climate change occurred, possibly driving late Pleistocene Darling Downs habitat contractions and species extinctions, irrespective of potential human occupation.

Although it may be over-simplistic to suggest that climate change drove Darling Downs megafaunal extinction, this research highlights the need to expand the project over wider temporal and spatial scales. That will allow testing of human versus climate hypotheses and will more precisely determine the operational details and mechanisms driving megafaunal extinction. It may be the case that humans played a more significant role elsewhere, but there is currently a paucity of data linking megafauna and human interactions.

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Fieldwork Report – Galapagos Islands, Ecuador

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The Galápagos Islands, 1000 km off the coast of Ecuador, are a National Park, UNESCO World Heritage site and a Biosphere Reserve. They are globally renowned for their ecological value and as a symbol of scientific discovery. The twelve researchers listed at the end of this report were lucky enough to have the Galapagos as a fieldwork site for the four weeks. Funded by an ARC grant held by Simon Haberle, Atholl Anderson and Henk Heijnis, the Galapagos work is part of a larger investigation into pre-European Pacific migration. The project aims to determine the extent that remote eastern Pacific Islands (Cocos, Galápagos, Desventuradas and Juan Fernandez archipelagos) were used as 'stepping-stones' for interaction and material exchange between Amerindian and Polynesian people.

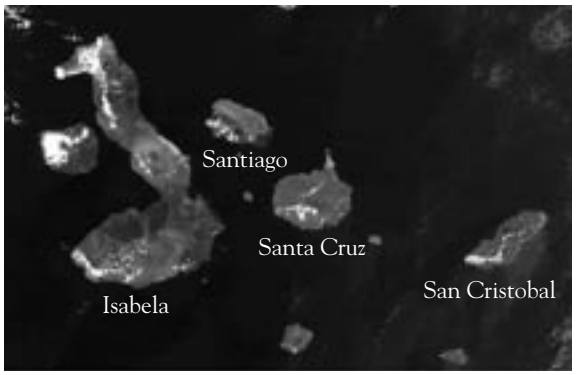

Figure 1 Map of the Galápagos Islands, with islands visited during this fieldtrip labeled

The Galápagos research will combine fine resolution archaeological, palaeoecological and dating techniques to determine the age and nature of the first human occupation in the archipelago. Evidence of pre-European human activity, climatic variability (including El Niño) and its possible effects on Pacific colonisation are of primary interest.

For the most part, the fieldwork was conducted in two separate groups, moving between the islands of Santa Cruz, Santiago, Floreana and Isabela (See Figure 1) by live-aboard boat.

Palaeoecology

Sediment cores were taken from three *Sphagnum* bogs in the highlands of Santa Cruz; all are 3.5 to 4 m long, bottoming in grey clay. They were extracted using a 50mm diameter Livingston corer and Cap'n Jim Neale's 100mm diameter "Bog Killa". Previous investigations by Paul Colinvaux indicate that the basal sediment may be about 1500 years old in a similar Santa Cruz bog (Colinvaux, 1968).

As well as the highland sites, the edges of two ephemeral saline lakes in volcanic craters on Santiago (Figures 2 and 3) were cored. In one of these craters, formerly a salt mine, we extracted 3.5 m of sediment using a Livingstone corer, and in the other, 1 m of sediment was taken using a C-section probe.

Three coastal lagoons, one each on Santiago (Espumilla Lagoon, James Bay), Floreana (Flamingo Lagoon, Punta Cormoranta) and Isabela (Isabela wetlands, Puerto Villamil) also yielded sediment. Espumilla and Flamingo Lagoons were both cored with the Livingston corer, and produced about 3.5 m and 4 m of sediment respectively. At the Isabela wetlands (a RAMSAR site, and excellent flamingo-watching location), we managed to make

Figure 2 Crazed smile on the face of Dr Cindy Froyd on her first sighting of the lake in Crater del muerte 200m below.

Figure 3 Crater del muerte

use of a paddle-boat normally used for tourist trips around the lake. It proved to be a perfect coring platform, and we extracted 6 m of sediment using the Livingston corer in about 1 m of water.

Duplicate cores were taken in all locations, and they will be divided up between Oxford and ANU for high resolution analysis of microfossils, macrofossils, charcoal (including species identification), ^{210}Pb and ^{14}C wiggle-match dating. We will examine changes in the vegetation of the Galápagos Islands over the last ~5000 years, particularly focusing on changes over the last 1000 years, the period over which anthropogenic activity has had an impact. The native ecosystems of the Galápagos are currently threatened by extensive marine and terrestrial habitat degradation and have incurred widespread introductions of non-native species since the time of European colonisation. The timing of these introductions and the natural fire history compared with any anthropogenic influence, is of importance to conservation managers working in the Charles Darwin Research Station in the Galápagos, and will be a major area of our research.

Archaeology

The archaeological team focused their efforts on coastal sites identified by Thor Heyerdahl and Arne Skjolsvold during their 1953 expedition. Heyerdahl and Skjolsvold investigated surface scatters of potsherds and excavations to a depth of 50 cm on Santiago and Santa Cruz islands. The collection is now held at The Kon-Tiki Museum (Norway) and contains charcoal and pottery of Peruvian and Ecuadorian origin that was said to stratigraphically underly the Spanish artefact layers (Heyerdahl and Skjolsvold, 1990).

The aim of this field trip was to re-excavate sites in Whale Bay, Cabo Colorado (Santa Cruz), James Bay, Buccaneer Bay (Santiago) Black and Beach (Floreana). Artefacts and charcoal material recovered in stratigraphic context will be used to test the hypothesis that the islands were visited or occupied by Amerindians prior to their European discovery in 1535 AD.

All Heyerdahl and Skjolsvold's sites, some of which had been damaged by recent construction, were mapped and systematically excavated to test propositions about the spatial and stratigraphic distribution of archaeological material. At several locations where no sites had previously been recorded, surface searches were conducted, and test pits dug. Sand augering was also carried out in dune areas. Local informants were questioned about water sources and whether they had found pottery or other archaeological material on their land.

Archaeological material retrieved during the trip will be analysed at Cautivo Archaeological Laboratory, Ecuador, and the ANU. Earthenware will be compared with other South American collections, for clues as to its age and history. ICPMS analaysis on sherds will provide information about the type and origin of the fabric, and OSL dating will be carried out. Pollen, phytoliths and charcoal found in the archaeological excavations will also be analysed.

The final item to report is that Henk's birthday was celebrated in style (Figure 4) with some delicious local pink champagne!

Fieldwork team

Palaeoecology: Dr Simon Haberle, Iona Flett (ANU), Dr Henk Heijnis (ANSTO), Dr Kathy Willis, Dr Cynthia Froyd (Oxford University, UK), Mr Jim Neale (Soft Core Technologies, Australia)

Archaeology: Prof Atholl Anderson, Mrs Rosanne Anderson (ANU), Dr Karen Stothert (University of Texas, San Antonio), Mr Cesar Veintimilla (ESPOL, Guayaquil), Dr Paul Wallin, Dr Helene Martinson-Wallin (Kon-Tiki Museum)

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Figure 4 Atholl, Henk, Iona, Jim, Cindy, Rosanne, Simon

Quaternary Research at Southern Cross University

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The Centre for Geoarchaeology and Palaeo-environmental Research (CGPR) conducts research into past vegetation and soils and past cultures and civilisations to understand the effects of past environments and climates on the development of modern societies and cultures.

Studies encompass geomorphology, sedimentology, geochronology and palynology (especially pollen, phytolith, diatom and starch analysis). Research and consultancy is conducted in eastern Australia, Thailand, Vietnam and the Pacific Islands.

The centre is currently composed of the following academics and post graduate students.

Associate Prof Bill Boyd (bboyd@scu.edu.au)
Bill is currently on study leave completing writing up for the geoarchaeological contributions to the Otago University/Thai Fine Arts Department Origins of the Civilisation at Angkor Archaeological Project. This work focuses on the late Holocene environment of the Mun River upper valley, a tributary of the Mekhong River in NE Thailand. The work has focussed on hydrological change over the last 4 ka, and vegetation history and human land management during the last 2 ka. Work at new sites continues, with plans to extend the pollen analyses back into the mid and early Holocene.

Bill's Holocene environmental work in West New Britain (PNG), running in association with the Australian Museum's Prehistory of West New Britain Archaeological Project, also continues, with the recent submission of papers reviewing the palaeoecological pollen- and, especially, phytolith-based work, and focussing on the interactions between prehistoric people, catastrophic vulcanism and wet tropical rainforests.

Finally, Bill's Holocene sea-level and coastal evolution studies in and around the Red River Delta area of Vietnam (a joint project with the Vietnamese Institute of Geology) continue.

Bill has also recent published a new text book (Boyd, B. and Laird, W. 2005. *Analysing Global Environmental Issues: A Skills Manual*. Pearson, Sydney), which, while focussing primarily on contemporary environmental issues, also concerns itself with long-term environmental and climate change.

Dr Kathryn Taffs (ktaffs@scu.edu.au)
Kathryn is a palaeoenvironmental historian using pollen and diatoms to reconstruct the environmental history of natural areas. She has a close association with management agencies, so her research is often conducted as a component in a multidisciplinary team. Results from the environmental histories contribute to setting remediation targets for management plans of areas adversely affected by human activity.

Recently, Kathryn has been working on a diatom based calibration set for coastal lakes in northern NSW. Sampling has included lakes on the coastal plain from Coffs Harbour to Tweed Heads. The calibration set will assist interpretation of long term environmental records being investigated in the northern NSW region by students of Southern Cross University.

The coastal lakes used in the calibration set have also been sampled at monthly intervals over a 12 month period to examine diatom seasonal changes in lakes of this kind. Many of these lakes are affected by algal blooms. Greater knowledge of diatom abundance and diversity across seasonal changes will assist management of these lakes.

Kathryn recently spent a period of study leave at Queens University, Canada, collaborating with Canadian colleagues on anthropogenic impacts upon wetland ecosystems using fossil diatoms as bioindicators. An outcome of this collaboration will soon be a taxonomic guide to diatoms in coastal, semi-tropical environments.

In the near future Kathryn is beginning a project investigating the history of eutrophication of east Australian estuaries, including those in the Great Barrier Reef and Morton Bay. Currently a PhD scholarship is available and Kathryn is seeking applicants for this position.

Dr Steve Abbott (sabbott@scu.edu.au)
Steve Abbott continues to work on the sedimentology and sequence stratigraphy of shallow marine successions in New Zealand and Tasmania. Recent fieldwork in the Tasmania Basin has produced a suite of correlated stratigraphic columns of the Late Permian Ferntree Formation that reveal cyclicity on several scales. Time Series analysis of gamma logs is in progress in collaboration with Graham Weedon to test for the presence of Milankovitch periodicities. A recent highlight from the New Zealand work is a contribution (with Brent Alloway, Bob Carter, Tim Naish Brad Pillans and others) to several papers on the Plio-Pleistocene of the Wanganui Basin. These papers will appear in a forthcoming special issue (New Zealand Plio-Pleistocene cyclostratigraphy) of the *Journal of the Royal Society of New Zealand*.

Dr Jeff Parr (jparr@scu.edu.au) Post Doctoral
Jeff's background is in fossil phytolith and starch research including studies on environmental and vegetation history, particularly in Australia and New Guinea, and the residue analysis of artefacts such as stone tools and pottery. His most recent work has involved investigating the long term storage of carbon in soils. Jeff's recent research with Leigh Sullivan at SCU has demonstrated that organic carbon locked up in fossil phytoliths is stable for thousands of years and over time may become the dominant form of soil carbon in buried topsoils. In addition, Jeff has also recently done some collaborative research with Evelyn Krull and Jan Skjemstad, from the CSIRO and CRC for Greenhouse Accounting, and Erick Bestland of Flinders University on the formation of the Terra Rossa Soils in the Coonawarra Area of South Australia. The research was conducted using a combination of techniques, including isotopic ($\partial^{13}C$, $\partial^{15}N$, ^{14}C), spectroscopic (^{13}C-NMR, MIR), optically-stimulated luminescence dating (OSL) and phytolith analyses. The results will be available soon in the journal *Geoderma*.

Jo Green (jogreen@nrg.com.au) PhD student
Jo has commenced a PhD project investigating the restoration of salt marsh communities in eastern Australia. Diatom abundances and ecological tolerances provide background to the study, on the

algal species found along the different gradients of the saltmarsh ecosystem and colonisation rates of the surface sediments after various forms of restoration have occurred. The study aims to test diatoms as early indicators of the restoration of a functioning ecosystem, to provide essential information to management.

Preliminary results in the first year after rehabilitation show strong differences in the relative abundance and species composition between the rehabilitation areas and the reference/control areas, indicating that the more dominant species may be useful indicators of a pathway to a desired restoration condition.

Leigh Jago (leighjago@hotmail.com) PhD student
Leigh's research, near completion, has concentrated on the fossil pollen history of West New Britain, Papua New Guinea for the past 3000 years. A main objective is to investigate and record the evolution of the Holocene vegetation in a region characterised by periodic catastrophic volcanism. The region provides an excellent laboratory to examine the resilience of tropical rainforest to major environmental disturbances which also include landform and hydrological change. Furthermore this research integrates with archaeological investigations into the movement and settlement of Lapita in the area. Fine-resolution AMS radiocarbon dates from clearly bedded peats and volcanic ash provide accurate dating of tephra events for other researchers in the region, and the pollen and spore inventory from this study will add valuable data to the scant palynological records of lowland PNG.

Dr Carol Lentfer (clentfer@scu.edu.au) Adjunct Fellow
Carol is an Adjunct Fellow of SCU and Postdoctoral Research Fellow, University of Queensland. She has a number of ongoing projects including: building a modern starch reference collection for the plants of Southeast Asia; investigating the palaeoenvironmental and economic change at the Liang Bua *H. floresiensis* archaeological site in Indonesia; tracing antiquity of banana domestication and cultivation in the Indo-Pacific region; and palaeoenvironmental impacts of volcanoes and people in West New Britain, Papua New Guinea.

For more info on CGPR:
http://www.scu.edu.au/schools/esm/palaeo/

A brief report from University of Newcastle Geography & Environmental Science research lab

Stuart Pearson

University of Newcastle
and Land and Water Australia, Canberra (stuart.pearson@lwa.gov.au)

We've been working on finer spatial scale and shorter temporal scale environmental history using tree ring analysis and stick-nest rat middens. Working with AINSE's Quan Hua and NTU's David Bowman, we have used the radiocarbon bomb pulse to test the assumption of annual ring formation in *Callitris glaucophylla* and *C. intratropica* in central and northern Australia. We have been able to resolve false and missing rings using the annual resolution of AMS dates on individual tree rings formed during atmospheric bomb testing periods. This tested assumption provides a foundation for exploring longer (> 300 years) tree ring records, more extensive (>50% of land mass) arrays of site specific (ca 5 metre) records and ones that are directly ecological.

Extension into mallee Eucalytpus and mallee pines (*C. intertexta*) near Cobar has begun (Sarah Harvey, Honours 2004). We have already collected extensively from the Pilliga in sites with known regeneration and disturbance histories (Rachel Gleason, incomplete Honours 2003).

Ongoing stick-nest rat midden work (Erin Greentree, Honours 2005) has provided long (200-5000 years), spatially constrained (30 metres) and spatially extensive (arid zone) information about plants and animals in the Yathong Nature Reserve.

Lucyna Gayler has continued her PhD research on the deposits of the Paroo catchment and has also a beautiful baby boy, Gabriel. Robert DeVries has started a PhD working with massive databases and GIS models to understand rainforest dynamics. He is able to do "what if" scenarios using these models.

Stuart Pearson has left the University of Newcastle and is now working in Natural Resource Management for the Federal Government in Canberra.

Tenth Conference on Australasian Vertebrate Evolution, Palaeontology and Systematics (CAVEPS) and Quaternary Extinctions Symposium

29 March – 2 April 2005, Naracoorte, South Australia

Esmée Webb

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Like AQUA conferences, CAVEPS is held biennially at different locations either in Australia or, less often, in New Zealand. I first attended CAVEPS in Perth in 1997 largely because Alex Baynes organised a special symposium on Quaternary extinctions. I attended the Naracoorte meeting because the organisers, Steve Bourne and Liz Reed, decided the time had come for another symposium on the same topic, to assess how far the subject had progressed during the intervening eight years. The short answer is: not very much, but more of that anon.

CAVEPS began at 9 am on Tuesday 29 March, meaning that the far-travelled had to reach Naracoorte on Easter Monday, and ran for two very full days, with a concurrent session on Wednesday afternoon on Devonian fish. Nearly 60 papers were delivered in the main sessions; 10 in the fish symposium, which I did not attend.

Tuesday morning kicked off with a session on Tourism and Education, followed by one on Heritage and Management. The papers in these sessions discussed such important topics as how we present our results to the public, how to educate the next generation to ensure a continuing supply of students who find science fun and worth doing, and how to manage National Parks so that they survive the numbers of people who want to visit them. I found Sue Turner's paper on how to turn your favourite patch of the great Australian bugger all into a geopark particularly inspiring. Ecotourism might well be a way of keeping parts of the outback reasonably pristine. It's something the Chinese are really good at.

After lunch, the papers became more palaeontological. The first session discussed Early Mesozoic Faunas, the second focussed on Reptiles. Over afternoon tea, we studied the posters into most of which much effort had been put. Already suffering serious brain overload, I at least found the food and, particularly, the wine offered by Orlando's Russett Ridge Winery that evening simply too much. I staggered off to bed quite early, my brain buzzing with unfamiliar concepts.

Wednesday began, again at 9 am, with a session on Phylogeny and Early Mammals, followed by one on Tertiary Mammals and Sites. After lunch, the non-piscatorial progressed to Quaternary Mammals and Sites followed by Functional Anatomy. I must confess that some of the theoretical phylogenetic papers left me gasping, I was so far out of my depth. I can see that supertrees are probably important, but they are surely only as believable as the taxonomy on which they are based? Once we got on to anatomy and site descriptions I felt more able to cope and contribute, although the topics varied greatly. All sorts of vertebrates were discussed, from dinosaurs to diprotodons, but not humans.

After a short 'beer break', those with more energy than me reconvened for a student forum. I had been badly bitten the night before by mosquitoes and needed to take evasive action. The Naracoorte area is not called the 'mosquito plains' for nothing, alas!

On Thursday, all the sessions took place in Blanche Cave, an appropriate venue in which to discuss cave palaeontology, particularly the contribution made by Tenison-Woods to our understanding of Naracoorte. Seven of the 20 papers in this all-day session focussed on Naracoorte, but the Nullarbor, Riversleigh, Wellington, Yosemite, the USA more generally, Borneo and New Zealand also got a look in. The quality of the presentations was high; while

the lunch was superb! Actually, all the food provided for the conference was excellent. I, at least, had to eschew lunch, or I would have dozed more often and more blatantly than I did when the lights dimmed each afternoon.

Friday and Saturday were devoted to the Quaternary Extinctions Symposium. These sessions began with three overview papers by authors unknown to each other previously who all said more or less the same thing: the rate and scope of vertebrate extinction varied from continent to continent, one size does *not* fit all; probably both humans and climate were involved, but to differing degrees in different places; so, much more detailed, dated information is needed before we can put the debate to rest.

The subsequent sessions, comprising 20 papers, considered the Patterns, Timing and Modelling of Extinctions, Australian Faunas and Extinctions, Environment and Extinctions, Site Studies and Modern Faunas, and Humans and Extinctions. Saturday afternoon was devoted to posters.

Divisions and disagreements began to emerge quite quickly during these sessions; maybe they were also there in the CAVEPS sessions, but passed me by. Some of the archaeologists were vocally unhappy that the Quaternarists generally accepted that people reached Australia >50 ka BP. The archaeologists were equally unhappy to be told that some species of the Australian megafauna became extinct >45 ka BP, while some sites long touted as megafaunal kills also predate human arrival by millennia, whichever timescale one favours. For example, Lancefield dates to 80-70 ka BP, not >20 ka BP, as originally suggested. Megafaunal sites on Kangaroo Island are equally old and equally lacking in evidence for human interference. Even in Tasmania it appears that people did not interact with the megafauna; the oldest archaeological sites contain only Recent species. Cuddie Springs, of course, remains a problem because it appears to record human interaction with extant megafauna as late as 36 ka BP. A new dating programme is proposed for this site, which may resolve this conundrum.

The conference dinner was held on Thursday night, after which most of the CAVEPS people left. The Quaternary folk had arrived that morning, but there was very little overlap between the two sets of conferees, it seemed to me. Am I alone in finding the categories into which we divide knowledge worrying? I realise that contemporary polymathic Renaissance people have rather more to cope with than their fifteenth century forebears, but if the sciences are to survive in a clearly hostile environment, we need to climb out of our boxes and 'visit' (as the Americans would say) those working in adjacent disciplines, as often as possible. Would a little more synergy not be mutually useful?

On Friday evening participants were given the chance to visit the Naracoorte caves, free of the usual tourists. The conference ended on Saturday night with a bountiful and well-wined barbecue, during which the heavens opened. Given how dry the country was, we were probably the only people who were dismayed by the rain. It did not dampen people's spirits, however. Many partied on long after I went to bed.

So, which were the outstanding papers and what really impressed me? To answer the latter question first: the number of students who presented excellent papers and/or posters was impressive. Nearly half (44%) of the CAVEPS papers were by students; as were 30% of the fish papers. For whatever reason, there were fewer student presentations in the Cave symposium (21%) and the Quaternary Extinctions sessions (17%). The presentations that stand out in my mind a week after the event are the rotating 3-D image of an early vertebrate skull made by computer wizardry, Tony Barnosky's masterly overview of the megafaunal extinction debate and Peter Kershaw's summary of Late Quaternary environmental evidence. Other participants would undoubtedly highlight other contributions. Indeed, 'comparisons are odious'. This was an excellent conference. All the papers were interesting. They will be published in *Alcheringa* in mid-2006. It ought to be a sure-fire best seller!

The CAVEPS conference was preceded by a two-day opportunity to examine the Naracoorte caves and Limestone Coast and followed by a week-long excursion to the Flinders Ranges. I went on neither because I had been lucky enough to visit all the sites in 1998. I am sure these excursions were well organised, informative and fun, however, because the whole conference was. The organisers, Steve Bourne and Liz Reed, are to be congratulated on organising one of the best conferences I have been to for a very long time; and the one with the best satchel! Rust-red canvas with tan leather straps and handles and the conference details embroidered, yes – embroidered!, in gold (yellow) thread; very useful, very striking.

International Symposium on New Approaches to Quaternary Sciences in Fuego-Patagonia

Puerto Natales, Magellanes, Chile, April 4-9, 2005

Brent Alloway

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Figure 1 The famous and dramatic granite pillars of Torres del Paine vertically rising to 2800 m.

Rugged, mountainous and stormy, Region de Magellanes is the heart of the Chilean Patagonia and Chile's southern-most (XII) region. Its remote, harsh but pristine environment along with its close proximity to Tierra del Fuego and Antarctica is enough to make you wonder why the early English, Scottish and Croatian immigrants settled here to raise sheep in the first instance. Certainly this wild landscape is nowadays the playground for adventurers, many of whom visit the soaring granite pillars (Figure 1), creeping glaciers and dense *Nothofagus* forests of Parque Nacional Torres del Paine before or after continuing onto Argentina.

The International Symposium on *New Approaches to Quaternary Sciences in Fuego-Patagonia*, sponsored by the Universidad de Magellanes, Centro de Estudios del Quaternario de Fuego-Patagonia y Antarctica (CEQUA) and Queens University-Belfast, was held at Puerto Natales on the picturesque shores of Seno Ultima Esperanza (Last Hope Sound) the southern terminus of the ferry trip through the Chilean fjords (see inside front cover). The aim of this meeting was to stimulate and promote Quaternary research and collaboration in this region. CEQUA and Universidad de Magellanes are fledging institutions in the process of establishing themselves in the international Quaternary arena and busily working away to build capability. I was very impressed to learn that many of the Chilean attendees at the symposium were in fact conducting PhD studies around the world (i.e. University of Western Ontario; Cambridge, UK; UNAM, Mexico; University of Auckland, NZ) and were intending to return to Universidad de Magellanes to assume lecturing and research leadership roles. One has to admire this strategic vision and investment.

Invited speakers at the symposium included: Carolina Villagran and Patricio Moreno (Universidad de Chile), Ricardo Villalba (IANIGLA, Argentina), Eric Colhoun (University of Newscastle, Australia), Keith Bennett (Uppsala Universitet, Sweden), Brian Luckman (University of Western Ontario, Canada), Luis Borrero (CONICET, Buenos Aires, Argentina) Cathy Whitlock (Montana State University, USA), Alan Cooper (Oxford University), Gill Plunket (Queens University, Northern Ireland), Scott Ishman (Southern Illinois University, USA) and yours truly from New Zealand. Most talks focussed on providing excellent reviews of recent and/or on-going paleoenvironmental research conducted in the Magellanes region. Some papers like that of Eric Colhoun, Brian Luckman, Alan Cooper and Gill Plunket focussed more on how various sorts of research being conducted in their own countries could be applied to the Magellanes region. I was pleasantly surprised to learn that the Australian sphere of research influence had extended all the way to the Magellanes region: our recent past president, Simon Haberle's work on post-glacial lakes in southern Chile was enthusiastically referred to in Keith Bennett's presentation.

My talk focussed on the recently published (March, 2005) NZ-INTIMATE poster that details both high resolution and fragmentary palaeoclimate records over the last 30 ka and it was emphasised that this poster might be a useful template for the palaeoclimate community of southern South America (Cono Sur) to adopt. This suggestion was enthusiastically received. Certainly, both New Zealand and Cono Sur share many things in common (sheep aside). For instance, both areas are considered sensitive monitors of climate change since they are the only significant landmasses in the Southern Hemisphere westerly circulation zone, a critical transition zone between sub-tropical and Antarctic influences. Both regions also have mountainous terrains which amplify the climate signals and consequently, their environmental gradients are highly sensitive to subtle changes in atmospheric and oceanic conditions. When Australian, New Zealand and Cono Sur regional records are finally compiled and compared, the broader INTIMATE community will then be in a very strong position to critically evaluate differences in timing, duration and structure of climate events in the Southern Hemisphere. Certainly as the meeting continued the similarities between climate records of New Zealand and Cono Sur became more and more evident.

Eric Colhoun, recently awarded lifetime AQUA membership at the Biennial Conference held at Cradle Mountain, Tasmania, gave a terrific (but not an entirely unfamiliar) talk on the development of a glacial history for Tasmania. Eric described how recent advances in cosmogenic dating have been pivotal to the establishment of more robust age control for cirque and valley glaciers, as well as useful for assessing the timing of maximum glacier advance during the LGM and for evaluating the presence of Late Glacial readvances. Mike Kaplan (University of Edinburgh) gave a complimentary outline of the Patagonian glacial record and recent cosmogenic dating being conducted between the Strait of Magellan and Torres del Paine. This record so far indicates that, on an orbital timescale, ice sheet

Figure 2 Alan Cooper (soon to be University of Adelaide) standing next to a 4 m high replica of the herbivorous *Milodon* (giant ground sloth) that stands outside the entrance of Cueva del Milodon located c. 24 km northwest of Puerto Natales.

Alan holding some Milodon dung found on the cave floor (always a risky business picking up dung unless you can be really sure the material in question originated from an extinct mega-mammal!).

growth appears to be in phase with major Northern Hemisphere ice sheet change, while at sub-orbital timescales, other Late Glacial events may in fact be in step with the climate of Antarctica and the surrounding ocean. This talk was music to my ears, though it does remain a mystery to me as to why there is no evidence for Late Glacial readvances in Tasmania.

Alan Cooper (Oxford University – soon to be 'deported' to Adelaide University) emphasised the importance of ancient DNA in providing a huge range of opportunities relating to the evolution and ecology of animal and plant populations as well as the effects of climate change, human impact and mass-extinctions. This talk was most appropriate in lieu of the conference field-trip to the famous Cueva del Milodon. Here, Hermann Eberhard discovered the well-preserved remains of a ca 4 m-high ground sloth in the 1890's (Figure 2). Since this initial discovery much archaeological work has been conducted (some high-quality professional excavations but unfortunately a lot more archaeo-vandalism conducted by amateurs) and confirmed the association between human artefacts and Pleistocene mega-mammals. Despite the presence of numerous archaeological excavations, you can still see the remains of Milodon dung and fur strands scattered over the cave-floor (Figure 2). You can image how excited Alan became with all these DNA possibilities. As for me, with all the mega-mammal droppings around, I just watched where I stood.

Another highlight of the conference was visiting Parque Nacional Torres del Paine: plenty of condors, Guanaco (large Llama) (see front cover), Nandu (lesser Rhea) and foxes to be seen around this recently fire-ravaged park. But the visual prize must surely be the truly magnificent and breathtaking set of granitic towers majestically extending up to 2,800 m. Surely, if Peter Jackson had laid his eyes on this place then Magellanes would have been Tolkien's middle-earth instead of NZ.

So did the conference achieve what it was intended to do ? I believe it did; it was a privilege to be exposed at close quarter to the promising research that my South American colleagues were engaged in (Figure 3). Certainly there are considerable efforts being undertaken to unravel the palaeoenvironmental history of this area. In terms of reconciling equivalent-aged southern mid-latitude palaeoclimate records and relating changes to circum-Antarctic circulation, changes in the tropics, or even events in the North Atlantic, the strategic relevance of this work is extraordinarily high. A key difficulty for southern South American researchers (as for NZ researchers) is access to analytical and dating facilities. Collaboration and research exchange is therefore essential as capability is progressively built and resources steadily acquired. For me, I was motivated to submit an ISAT-Linkages Proposal as soon as I got back to NZ from the symposium. The purpose of this fund is support the development and enhancement of research relationships with other countries with an emphasis on supporting new activities and relationships. It is hoped that two prominent palaeoclimate researchers (one from Chile and the other from Argentina) will attend the NZ- or Australasian-INTIMATE Meeting with the aim of strengthening linkages and commencing comparison between our respective SH records.

Finally, I would like to acknowledge and warmly congratulate the organising committee for a well-organised and informative conference. In particular, I would like to acknowledge the hard-working efforts of Dr Victor Fajardo Morales (Chancellor, Universidad de Magellanes), Dr Pedro Cuandra Burgueno (Director, CEQUA), Dr Patricio Moreno Moncada (Universidad de Chile), Dr Claudio Casiccia Salgado (CEQUA) and last but no means least, Patricia Vukasovic Milovic (Universidad de Magellanes). Muchas gracias por darme la oportunidad de participar en este simposio. Ha sido para mi un gran privilegio.

Figure 3 Conference attendee's with Seno Ultima Esperanza (Last Hope Sound) in the background. Dr Pedro Cuandra Burgueno, Director of CEQUA, is seated in the front centre.

Towards a climate-event stratigraphy for New Zealand for the past 30,000 years -

An evaluation of the 2005 NZ-INTIMATE Meeting

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More than 30 geoscientists representing a range of disciplines met at the Institute of Geological and Nuclear Sciences (GNS) Rafter Laboratory in Lower Hutt in early July to present new developments in the quest to prepare a definitive climate-event stratigraphy for the New Zealand (NZ) region since 30 ka (all ages in calendar years unless noted otherwise). The meeting, ably convened by Brent Alloway (GNS) and Jamie Shulmeister (Canterbury University), was the second to be held by the NZ-INTIMATE (NZ-INT) palaeoclimate community.

The first NZ-INT meeting, held in August 2004 (Alloway, 2004), was successful in that one of the initial objectives, to publish a poster documenting a series of well-dated, high-resolution on-shore and off-shore proxy records from a variety of latitudes and elevations on a common calendar time scale, has now been achieved (Barrell *et al.*, 2005). The poster depicts high-resolution records for the LGM and the Last Glacial-Interglacial transition (LGIT) from Auckland maars, Kaipo and Otamangakau wetlands (eastern and central North Island [NI]), marine core MD97-2121 (east of southern NI), speleothems (northwest South Island [SI]), Okarito wetland (southwestern SI), and ice-core records from Antarctica (EPICA Dome C) and Greenland (GISP2) for comparison. Fragmentary records comprising compilations of glacial sequences, fluvial sequences, loess and aeolian quartz accumulation are also included on the poster. A major advantage immediately evident is the way all the records, apart from the speleothems, are linked precisely by one or more rhyolitic tephra layers. A key marker is the very widespread Kawakawa Tephra (KKT) erupted from Taupo volcano ~26.5 ka. Inset maps on the poster show NZ's oceanographic setting, principal currents and water masses, glacier extent, and the distribution of vegetation zones at ~22 ka and at modern times (derived from inferred vegetation distribution at c. 1250 AD, just before initial deforestation by Polynesian settlers). The accompanying text provides further information and references. Other outcomes from the 2004 meeting included construction of a palaeoclimate website at www.paleoclimate.org.nz and an e-discussion facility at http://groups.yahoo.com/group/nz-paleoclimate-community (Alloway & Shulmeister 2005).

Making progress

What progress was made at the 2005 meeting? Firstly, after an introductory overview by the convenors, 18 papers were presented. Some were updates on research reported in 2004, but in others work from new sites or new interpretations were presented. The main findings are summarised below.

(1) A review paper on Antarctic and Greenland ice cores concluded that the EPICA Dome C core currently provides the best Southern Hemisphere record for NZ-INT purposes because it has the highest resolution for the OIS 2/1 period and is the most precisely dated (Naish and Bertler, presented by Alloway). The second EPICA core (from Dronning Maud Land, being drilled) is expected to provide an even better record.

(2) A benchmark speleothem compilation from both North and South islands defined seven climatic events, dated via >74 TIMS U-series ages, using $\partial^{18}O$ measurements to reconstruct temperatures: event-1, LGM; event-2, late-glacial warming ~18.2-14.8 ka; event-3, late-glacial optimum 14.8-13.2 ka; event-4, late-glacial reversal 13.5-11.6 ka; event-5, early Holocene optimum 11.6-10.8 ka; event-6, mid-Holocene variability; event-7, late Holocene warm interval 1-0.5 ka (including LIA cooling ~0.4 ka) (Williams, King, Neil and Zhao). The speleothem records also showed statistically significant periodicities at decadal-to-century and millennial scales, the strongest being at ~3600, ~150, and ~100 years.

(3) The MD97-2121 marine record (Carter and Manighetti) and the montane (1000 m) Kaipo pollen

record (Lowe, Hajdas and Newnham) both showed close correspondence in timing with speleothem event 4, the late-glacial climate reversal beginning ~13.6 ka during the ACR (evident in both records) and concluding at 12.6 ka (Kaipo) or ~12.0 ka (MD97-2121) during the first part of the YD chron. A prolonged still-stand of sea level (-56 m) occurred at ~12.5 ka. At Kaipo the lowland podocarp: grasses (LPG) ratio, a surrogate for temperature (but see 4 below), indicated that conditions remained cool-but-warming from 12.6 to 11.9 ka. Both the MD97-2121 and Kaipo records contain the same suite of tephra markers and so can be reliably correlated. The Kaipo record was dated using wiggle matching of around 50 independent age points against INTCAL04 via OxCal. Radiolarian-based estimates of sea-surface temperatures (SSTs) in the MD97-2121 record showed steady, progressive warming during the LGIT (Hollis, Lüer, Scott, Neil and Manighetti).

(4) At Otamangakau (600 m) and Durham Rd (260 m), pollen records showed a possible climate reversal, or slow-down in rising winter temperatures, between 15 and 13.5 ka, and warming by 12 ka (McGlone, Turney and Wilmshurst). The impact of tephra fall was evident at Otamangakau where late-glacial vegetation was constantly disturbed for short periods by fallout. A major advance was the presentation of a newly-derived pollen-based transfer function (r^2 = 0.82) for mean annual temperature (MAT), presented appropriately enough by MATT McGlone. MATs were within approximately 3° C of the present by 17 ka and within 2° C by 14 ka.

(5) The long pollen record at Okarito is important because it spans the full last glacial-interglacial cycle (it also extends into MOIS 6) and it recorded high-resolution climatic changes including a mid-LGM warming and minor late-glacial reversal (Hendy, Vandergoes and Newnham). Because it lies close to Westland glaciers, Okarito provides direct correlation with deposits associated with their advance and retreat. It is linked via KKT to the MD97-2121 record and on-land NI sites including the Auckland maar records >800 km to the north. Dating with ^{14}C has not been straightforward but >80 ^{14}C dates have been obtained (plus OSL dates).

(6) A new record for subantarctic Campbell Is. (52° S) is an essential high-resolution reference sites for NZ-INT: it represents the lowest tree line in the region (~100 m), hence is very sensitive to fluctuations in summer temperature; the island is covered with blanketing peat and so long, high-resolution records can be obtained virtually anywhere; and there are restricted pollen and spore flora and close correlation of these with local vegetation cover (McGlone, Wilmshurst and Turney). MATs were at least 3° C lower than now from 17.0 ka, with moderate warming from 16.0 ka. Dating is currently underway to confirm the timing of an ACR-like interval of cooler climates between ~15.4 and 14.3 ka. Warming between 14.3 and 11.5 ka eventually attained MATs within 0.7-0.9° C of the present.

(7) The Auckland maar records provide potentially the best palaeoclimate records for Australasia (Augustinus, Shulmeister, Shane, Newnham and Alloway). Cores from Onepoto and Pukaki contain high-resolution records spanning 30-8 ka and those from Pupuke provide the Holocene component. All three cores were linked using tephra layers, and these, together with AMS ^{14}C dates, provide a tight chronology. The age control may be further improved using counts of laminae in parts of the cores to provide sub-decadal to possibly annual resolution. Pollen analysis and other proxies including magnetic susceptibility, grain size, elemental composition, $\partial^{13}C$ and $\partial^{15}N$, C/N ratios, and total OM were reported. Warming following the LGM began ~17.7 ka when podocarp forests expanded at the expense of beech forest, shrub and grassland. The pre-human Holocene record showed little change (i.e. stability). Palaeolimnological records from lakes in the Waikato region (e.g. Newnham *et al.*, 1999), dating back to ~20 ka, may complement the Auckland records but at lesser resolution.

(8) Loess and associated fluvial records from both SI (Almond, Hughes, Tonkin, Shulmeister, Barrell & Rieser) and NI (Litchfield & Palmer) were reported. Potential for deriving a novel palaeoprecipitation record using $\partial^{13}C$ measurements of pedogenic carbonate from loess near Banks Peninsula requires resolution of conflicting ages based on cryptic KKT and OSL and ^{14}C dating. In southern NI, loess accumulation was most extensive during the LGM but continued until 11.6 ka (from OSL dating). Tephras aided correlation and provided ages for fluvial terraces and loess deposits, the number of terraces being controlled partly by rates of tectonic uplift: areas with low rates (comparatively more stable) have more complete loess records (e.g. Wairarapa), those with high rates have more extensive fluvial records (e.g. Gisborne). An aeolian quartz flux record for the andesitic Taranaki region provided a proxy for palaeowind strength across the continental shelf off southwestern NI (Alloway). A quartz peak at 27

ka preceded deposition of KKT – marked by a drop in quartz flux – and a second occurred at 20-21 ka. The quartz flux dropped rapidly to 14.7 ka and then declined to the present. Sampling at finer intervals and measuring smaller (dust-sized) particles derived possibly from Australia offer potential for further study. On the basis of Δ15-bar water contents (field moist vs air dry) and Al/Si atomic ratios of allophanes within upbuilding andic soil materials, the LGM was dry but the early to mid-Holocene was wet.

(9) The extent of glaciers in NZ since ~30 ka, based on moraines and outwash surfaces and associated deposits, was reviewed (Barrell, Suggate, Almond and Rother). Glaciers were widespread in mountainous regions during the LGM but many areas became ice-free during the LGIT. Key events were: (i) advance to near full-LGM extent before KKT deposition (~26.5 ka); (ii) unknown amount of retreat; (iii) formation of multiple moraines at or inside the full LGM extent between ~23.5-19.0 ka; (iv) rapid retreat, glacier areas reduced by ~60-100%; (v) locally extensive 'late-glacial' advances in some high altitude catchments (HACs) ~14-11.4 ka; (vi) persistent glacier presence in HACs with multiple advances and retreats of uncertain extent after ~5.5 ka; (vii) rapid retreat since late 19th C. Based on a regional climate model embedded within an atmospheric GCM, and coupled to SSTs and sea-ice models, the extent and thickness of ice caps in NZ for the LGM were determined and climatic parameters simulated (Drost). Mean annual cooling was 4.5-5.0° C over NZ but influenced markedly by strong cooling over the Southern Alps. Removal of that component resulted in temperatures 2.5-4.0° C cooler than today's during the LGM, with maximum cooling in winter and in the SI. Precipitation was reduced everywhere during the LGM except eastern SI (always dry). The main zone of precipitation shifted westward along western SI because glacial ice expanded laterally and vertically. Changes in wind patterns influenced both temperature and precipitation, enhancing geographic differences and seasonality during the LGM. Westerlies increased over NI but reduced in eastern SI. An increase in southerlies (both frequency and strength) affected temperatures in the SI especially.

(10) The advantage of using tephra layers as isochrons to link and date most of the high-resolution palaeoenvironmental sequences in the NZ region was emphasised, but their ages needed 'sharpening' to meet the accuracy demanded for NZ-INT (Lowe, Hajdas, Newnham, Alloway and Hogg). Approaches include using Bayesian statistics (which allow the inclusion mathematically of stratigraphic information) and wiggle matching long stratigraphic sequences of ^{14}C ages. New ages (reported as 2σ ranges) were determined for late-glacial and early Holocene tephras using wiggle-match dating of the Kaipo sequence via Bayesian-based OxCal. The age of late-Holocene Kaharoa Tephra was determined via wiggle matching and dendrochronology (1314 ± 12 AD) and evaluated using Bayesian analysis. KKT, erupted during the LGM, is currently dated at 22.6 ^{14}C ka. However, attempts to reproduce this have been frustrated by a paucity of datable material preserved in chemically-stable sites, and in any event it is unable to be calibrated via INTCAL04. Other approaches include high-precision dating on appropriate material from carefully selected sites or new radiometric techniques (e.g. U-Th/He dating), or from the identification of tephras in ice cores or laminated sediments for which reliable calendar-age models have been constructed. Improved discrimination of tephras with ambiguous fingerprints requires new analyses of glass via microprobe or LA-ICPMS or of mineral phases (where available). Extending the known distribution of tephras into the SI or subantarctic islands by cryptic tephra analysis might add more tie-points between the records and hence allow climatic 'leads' or 'lags' to be determined. The distribution and stratigraphic relationships of tephras east of NZ were revealed by new piston cores obtained by Scripps' ship Roger Revelle (Shane, Sikes, Guilderson and others). A high-resolution record of interfingering rhyolitic, andesitic and peralkaline tephras was derived from 31 sites in Bay of Plenty, Hawke Bay, and Chatham Rise. The longest cores extended to ~50-70 ka. The tephras recorded activity from Taupo Volcanic Zone, White Is. and Mayor Is. Within the NZ-INT time period they included KKT and four derived from Mayor Is. (~20, 14, 8, and 7 ka) with distinctive peralkaline compositions.

What next?

A short discussion after the presentations concluded that two publications were now needed. Paper 1 is to critically evaluate the tephra framework for the NZ-INT timespan, led by David Lowe (Waikato University) with Phil Shane (Auckland University) and Brent Alloway. Paper 2 is to synthesise and evaluate the high-precision OIS 2/1 records into a provisional event stratigraphy. This paper is being coordinated by Brent Alloway and Jamie Shulmeister, and the groups involved with each proxy record. Ultimately, all NZ-INT members will be co-authors. A new project, strongly endorsed by the NZ-INT group, was the proposal by Helen Neil (NIWA) to obtain a marine core from the Tasman Sea not far off-shore from the west coast of SI – possibly in 2006 or 2007. A potential coring site has been identified by exploratory mapping and shallow coring. Such a core would help to link more directly the glacial records of

the SI and the various proxy records from elsewhere. NZ-INT members plan to informally review progress at the Geological Society of NZ annual conference in Kaikoura from 28 Nov-1 Dec 2005. The next Australasian INTIMATE meeting is scheduled for the Taipa Bay Resort, Northland, on 11 Feb 2006 (see http://www.sges.auckland.ac.nz/anzgg_2006/).

Summary of key points

(1) Speleothem records from both North and South islands provide a high-precision palaeotemperature record divided into seven climatic events. The record is exceptional because it has been dated by >70 TIMS dates that circumvent the calibration problems inherent in ^{14}C dating, and thus provides a benchmark to which other records can be compared.

(2) High-resolution pollen records at Kaipo, Okarito, and Campbell Is., well spaced latitudinally and altitudinally, are able to be enhanced through the development of a novel pollen-based temperature transfer function.

(3) Long lake records from the Auckland region offer very high resolution and potentially sub-decadal chronologies or better and have the advantage of providing a wide range of proxies that enable palaeoenvironments to be reconstructed in detail.

(4) Core MD97-2121 provides an exceptional high-resolution record of ocean change during the LGIT period that generally corresponds well with the Kaipo bog and speleothem records in timing.

(5) Apart from the speleothem and Campbell Is. records, tephra layers link all the records. The NI records, including MD97-2121, contain multiple tie points and isochrons. Crypotephrochronology could provide more. However, the precision of the ages on some of the tephras, especially during the LGM and LGIT periods, needs improving. KKT is a critical target because it is so widespread, and tephras marking boundaries of climate events (e.g. Rerewhakaaitu ~17.7 ka, Waiohau ~14.0 ka) are also targets.

(6) Currently the EPICA (Dome C) core provides the optimum ice-core record for correlation for NZ-INT.

(7) Records of glacial and associated deposits, loess, and aeolian quartz, although fragmentary, provide essential data and with improved dating potentially offer further insight into regional climate variations including 'leads' and lags'.

(8) Modelling of climates is important to provide an integrated overview.

(9) A new core from the Tasman Sea near Westland, if it can be funded, is urgent.

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New Zealand Friends of the Quaternary (FoQ) Field-Trip

Hawke's Bay region of eastern North Island, July 1-3 2005

Robert Langridge

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Friends of the Pleistocene (FoP) fieldtrips were resurrected in 2004 with a fantastic fieldtrip to North Island's Wanganui Basin. The name was subtly changed to 'Friends of the Quaternary' (FoQ) in support of national and international efforts to preserve the chronostratigraphic status of the Quaternary. The 2005 FoQ fieldtrip was held in sunny Hawke's Bay and led by Nicola Litchfield (GNS), Kyle Bland (Waikato University), Bruce Hayward (GeoMarine Research), Mike Page (LandCare Research) and yours truly. This field-trip aimed to highlight some of the wide variety of Quaternary research presently being undertaken in the region. This fieldtrip was again immediately prior to a NZ-INTIMATE workshop held at GNS-Gracefield on July 4th-5th (see report by David Lowe, page 27)

Hawke's Bay turned on typically fine, though cold, mid-winter weather. Though the wind did get through, at least we can say it did not rain. The FoQ trip had around 20 participants from as far north as Auckland in the north of NZ to as far south as Lincoln, which was a good size group for field tripping around the Bay. After meeting on Friday night in Napier, Day 1 got started with a visit to Ahuriri Lagoon just outside of Napier. This area is of course famous for not being a lagoon since 1931, when it was uplifted above sea-level by a large earthquake that destroyed the city of Napier. Bruce Hayward ably led two brief field stops to discuss his research into coring Ahuriri lagoon sediments to unlock the uplift/subsidence history of the site. We also stopped near the estuary mouth to look at some uplifted shell beds.

Figure 1 Kyle Bland discussing Pleistocene marine sediments at Devil's Elbow on State Highway 2 north of Napier, with field-trip coordinator Nicola Litchfield warmly wrapped up to the right.

From there the FoQ'ers headed north to look at some of the uplifted Pleistocene marine section at Devil's Elbow. Kyle Bland walked us through one of the cyclothemic cycles as exposed in the highway road-cut, in between the many passing cars and trucks.

These two stops showed up the diversity amongst the participants on the FoQ trip - from those who study late Holocene and historic events to others who are pushing the lower boundary of the Quaternary. This brought up many jokes about just what local "bedrock" or "basement" meant.

Day 1 proceeded on to Lake Tutira, a c. 6500 yr old landslide-dammed lake that has received much attention for its incredible record of late Holocene storm and post-human arrival sedimentation. Mike Page discussed the history of the lake and the rates of sedimentation coming from the surrounding Tertiary hill country under forest, scrub and pastured land use.

Nicola Litchfield led the next two stops farther north at the Mohaka River. Her post-doctoral work has focused on deriving the uplift record along the Hikurangi margin by utilising the abundant Last Glacial Maximum (LGM) fluvial aggradation surface as a marker for incision vs. uplift from several East Coast rivers. The incision and terrace sequences of the lower Mohaka River are very impressive. This was the official end of Day 1 activities, however, several members of the party broke off to visit the Mohaka River mouth and to collect boulder-sized pumice clasts that came down the Mohaka River c. 1850 yr ago following the Taupo eruption.

Figure 2 Mike Page (top left) and friends at beautiful Lake Tutira, our Day 1 lunchstop.

Day 2 started slowly. There were a few hangovers present after a good night out in Napier celebrating a famous thrashing of the Lions by the All Blacks. However, we finally made it out to the first stop, 50 km inland from Napier near Patoka. Rob Langridge led a long description of some trenching work done on the Patoka Fault – to determine its late Holocene slip rate and paleo-earthquake record. Enough said! One of the highlights of the trip followed. Though we were running late it was impossible to turn down the hot scones and tea on offer in the Halliday's farmhouse. Throughout the Patoka Fault study, "Mrs. H" had been instrumental in keeping the troops fed and once again the hospitality was overflowing.

From Patoka we went farther west to view the Ruahine Fault at Baldy Quarry near Puketitiri. This caused a split in the group with several of the GNS geologists being more interested in the Mesozoic bedrock than the discussion of the Tertiary geology and displacement style on the Ruahine Fault. Kyle Bland gave a good overview of the structure and Plio-Pleistocene history of the landscape between the Ruahine and Mohaka Faults. The last two stops were also led by Kyle. These involved a visit to an outcrop of Hukanui Limestone with impressive macrofauna. However, by the last stop - an overview of the geomorphology of limestone and Tertiary landscapes - people were getting quite cold, being exposed to the southwest winds. Some relief was gained when we came back to Balls Clearing for a lunch stop, wrap up, and hearty farewell before we all hit the road.

Many thanks to Nicola and the team for organising the field-trip, including the field guide (downloadable from: www.paleoclimate.org.nz), accommodation, and a sexy special issue FoQ t-shirt. Special thanks to Kyle for providing the overview and "glue" with his regional perspective and for adding stops at a late stage. A good time was had by all.

Reconstructing past climates for future prediction:

Integrating high-resolution palaeo data for meaningful prediction in the Australasian region, June 27-28, 2005

Pandora Hope

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It was Monday morning and we were at the 'shine-dome' of the Australian Academy of Sciences in Canberra to learn about the range of palaeo proxy data available for reconstructing the climate of the last five hundred to two thousand years in the Australasian region. The first formal presentation started late, but I thought it was very kind of the organisers to allow us more time to drink coffee, put up our posters and generally orientate ourselves. Then, we settled into the comfy couches. Chris Turney (University of Wollongong) made sure that we were all awake with his enthusiastic welcome, and Kate Harle (CSIRO Sustainable Ecosystems) gave us an excellent overview of some of the proxy evidence currently available in the Australian region, and how the broad range of climates in the Australian region can provide insight into global past climates.

Three talks on climate modeling followed. Bryant McAvaney (Bureau of Meteorology Research Centre) described the international Paleoclimate Modelling Intercomparison Project (PMIP) to compare the results of a range of different simulations from different climate models. The Holocene climatic optimum (6000 years ago) and the Last Glacial Maximum (LGM) were two time-slices examined. Bryant outlined the difference between full resolution global climate models (General Circulation Models - GCMs), that until recently commonly only included atmospheric processes, and those with lower resolution that included a greater number of systems such as oceans, the carbon cycle and vegetation (Earth-system Models of Intermediate Complexity – EMICs). As computers increase in their capacity, the higher resolution models can now include more features such as interactive oceans and vegetation. The international project is well into its second phase using these more complex models (http://www-lsce.cea.fr/pmip/). Matt Fischer (ANSTO) then described results from an embedded model with fine spatial resolution across Australia that not only outputs standard climate variables such as temperature and precipitation, but also the ratios of water isotopes. This extra step in the model allows direct comparison between field evidence and the model output. Finally, Amanda Lynch (Monash University) described the ways in which we can better estimate the uncertainties in climate model simulations, by producing within- and across-model ensembles and following experimental protocols that allow the assessment of sensitivity to a wide range of forcings.

Most of the modeling of palaeo-climates in Australia at present is using models developed overseas. Exceptions to this include the work of Josef Syktus (Department of Natural Resources, Mines and Energy, Queensland) with CSIRO's model, and the work using the University of Melbourne GCM that has a water isotope module. A new project combining expertise from the Bureau of Meteorology Research Centre and CSIRO to develop the Australian Community Climate and Earth System Simulator (ACCESS) will ultimately provide a climate model for use by all Australian researchers, hopefully including those studying past climates. During later discussion, Andy Pitman asked conference delegates to suggest additions to a new palaeo-model that would be most useful to palaeo-climatologists. One suggestion was for further 'transform' functions (beyond water isotopes) to be incorporated into the models so that they directly output proxy indicators, particularly for pollen analysis. These 'extra steps' could also be used to assess the impacts of climate change directly. As Kate Harle pointed out, many proxy indicators provide us with direct evidence of the impacts of climate change on various natural systems, with no need for further transform functions. Direct comparison could then be made between the models and palaeo evidence. Another point was made that a knowledge of the inter-seasonal variability in the past would be of great interest to people in agriculture. This highlighted a common theme throughout much of the conference – the need for well-dated palaeo climate evidence with high temporal resolution.

Over the long coffee-breaks and excellent food there was an opportunity to peruse the many posters and see some of the analyses of proxy evidence now becoming available. These included a number of reconstructions from speleothem sites, new analyses from ice cores and suggestions of points of caution to be noted during analysis. For example, J.P. Steffenson (Niels Bohr Institute, University of Copenhagen) reminded us that as we try to accurately place past climate records into context with global climate events, we should take great caution in 'wiggle-matching', to be aware of regional factors affecting the record and the physical mechanisms driving the shifts seen.

There were three discussion sessions, within which it became clear that high temporal resolution palaeo evidence spanning at least part of the last few thousand years appears to be relatively limited across Australia. Trees in Tasmania and corals off Queensland will probably provide the best records for temperature. New Zealand has more scope, with more trees of the appropriate type. Antarctica has excellent records from ice cores such as those cored at Law Dome, south of Australia. Speleothems provide records of hydrological changes with high temporal resolution. A number of other, coarser resolution proxies, including sedimentary records and the temperature changes determined in bore-holes, will provide further information. It was clear that there are still aspects of many of these records that need further work, and that inter-comparison between different records can be very informative.

Despite the limitations, Neville Nicholls (Bureau of Meteorology Research Centre) appeared confident that a 'hockey-stick' curve (à la IPCC 2001, Mann *et al.*, 1998) could be created for the Australasian region. (The usage of the term 'hockey-stick' was quickly knocked on the head.) He reminded us that such a curve would be of immense import to policy makers in the Southern Hemisphere. Depending on the temporal resolution of these time-series it may even provide insight relevant to today's agricultural practices. It was requested several times throughout the meeting that researchers with an appropriate dataset please contact Chris Turney.

Asian Lakes Drilling Programme

John Flenley

Massey University, Palmerston North, New Zealand

The Fifth Workshop Conference of the Asian lakes Drilling Programme was held in Palmerston North from February 27th to March 2nd, 2005, under the auspices of the Geography Programme, School of People, Environment and Planning, Massey University. Thirty five invited delgates from Japan, Sweden, Russia, Poland, Netherlands, USA, China, Australia and New Zealand presented papers on the theme "Environmental variability and human adaptation in the Pacific Rim".

The conference was entirely funded by Professor Yoshinori Yasuda of the Centre for Japanese Studies in Kyoto, Japan, and the local organiser was Professor John Flenley. Previous conferences in the series have been held in Japan, India and China. The conference was followed by a three-day tour of the Central Volcanic Region of the North Island. Fifteen of the conference delegates then continued on a research visit to Easter Island, in which the sediments of the three main volcanic craters were cored, to a maximum depth of 25 m. This was a reconnaissance visit for a trip planned for September, 2005 in which it is hoped to core to 50 m depth, with the intention of producing a full reconstruction of the palaeoenvironment of the island.

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FORTHCOMING CONFERENCES & MEETINGS

The 6th International Phytolith Meeting

Barcelona, Catalonia, Spain
5-8 September 2006

The conference will be organized by the Catalan Institution for Research and Advanced Studies (ICREA), The University of Barcelona, Spanish Council for Scientific Research (CSIC) and the University Rovira i Virgili of Tarragona.

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10th International Paleolimnology Symposium

Duluth, Minnesota, USA
25-29 June 2006
http://www.geo.umn.edu/paleolim10/

The symposium theme, "Past Ecosystem Processes and Human-Environment Interactions" emphasises the importance of paleo records in understanding global environmental impacts and their intersection with climate change. This topic is also a major focus of the IGBP-PAGES program.

Australasian Archaeometry Conference 2005

Department of Archaeology and Natural History
The Australian National University
12-15 December 2005
http://car.anu.edu.au/archaeometry_conference.

The 2005 Australasian Archaeometry Conference will be held at the ANU, Canberra, hosted by the Department of Archaeology and Natural History, RSPAS, and the Centre for Archaeological Research.

Details will be regularly posted on the conference website:

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4th "Climate Change: The Karst Record" International Conference

Baile Herculane, Romania
26-29 May 2006
http://www.karst.ro

Contact: Russell Drysdale
(Russell.Drysdale@newcastle.edu.au)

This conference follows the highly successful Montpellier meeting in 2003. It is particularly dedicated to high-resolution palaeoclimate records from speleothems and studies focusing on linkages between climate and karst processes. Further details are now available from the conference web site.

Biogeochemical Controls on Palaeoceanographic Proxies

London UK
3-4 October 2005

http://www.open.ac.uk/personalpages/r.h.james/index.html

Celebrating 20 key years of Quaternary research

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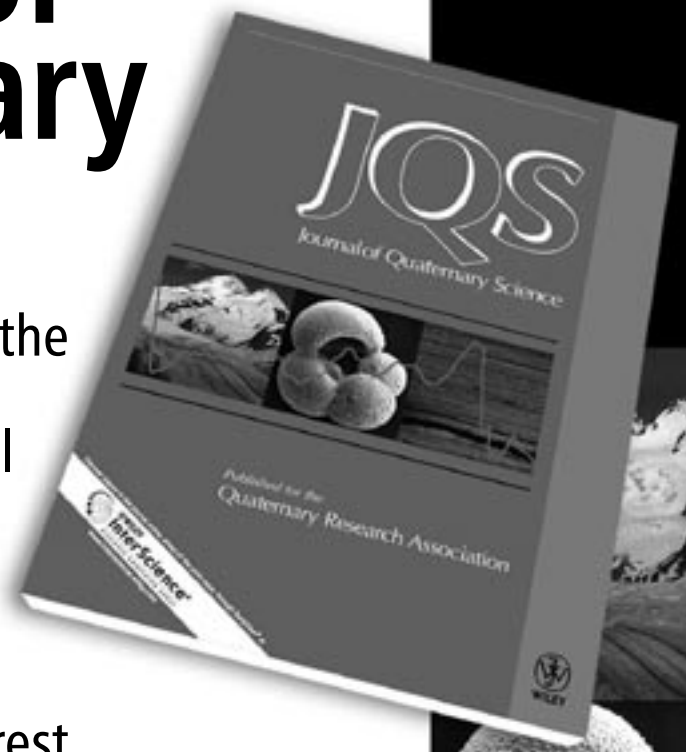

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The Australasian Quaternary Association (AQUA) is an informal group of people interested in the manifold phenomena of the Quaternary. It seeks to encourage research by younger workers in particular, to promote scientific communication between Australia and New Zealand, and to inform members of current research and publications. It holds biennial meetings and publishes the journal *Quaternary Australasia* twice a year. The annual subscription is A$35, or A$25 for students, unemployed or retired persons. To apply for membership, please contact Janelle Stevenson (address below). Members joining after September gain membership for the following year. Existing members will be sent a reminder in December.

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