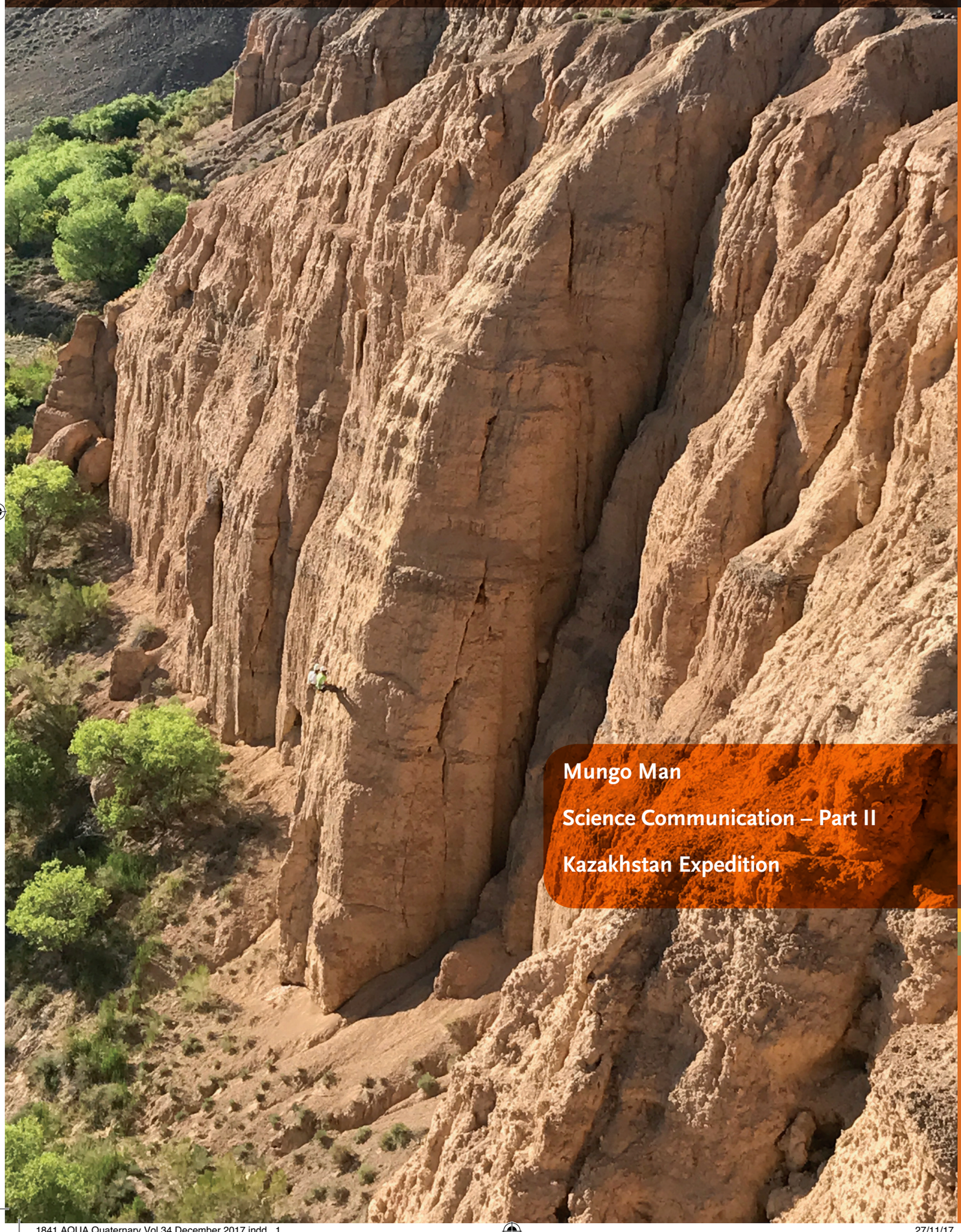
VOLUME 34 | NUMBER 2 | DECEMBER 2017

Quaternary AUSTRALASIA



Mungo Man

Science Communication – Part II

Kazakhstan Expedition

Southern Hemisphere Assessment of PalaeoEnvironments (SHAPE)

Workshop: Quaternary variability, abrupt change and tipping points
2-3 February 2018
Hosted at The School of Earth and Environmental Sciences
University of Wollongong, NSW Australia

Greetings,
SHAPE is an International Focus Group supported by the Palaeoclimate Commission of INQUA (PALCOM). It provides a support network for palaeoclimate / palaeoenvironmental research by Quaternary scientists working within the Southern Hemisphere. Details about SHAPE can be found at this website: www.inqua.org/PALCOM/pcSHAPE.html

We invite researchers who have an interest in climate variability, abrupt change and tipping points to participate in the upcoming SHAPE workshop on 2-3 February 2018, to be held at the University of Wollongong.

Wollongong is located approximately two hours south of Sydney by train. We have planned this workshop to occur immediately prior to the joint Australian Meteorological and Oceanographic Society/International Conference on Southern Hemisphere Meteorology and Oceanography (AMOS-ICSHMO) conference, which is being held in Sydney from 5-9 February 2018. Further information on this meeting can be found here: https://www.amos-icshmo2018.com.au

The workshop will produce a group synthesis paper on the current state of knowledge and future recommendations for the development of late Quaternary proxy networks and model simulations that capture evidence of variability, abrupt change and tipping points.

If you would like to participate, then please register here:
https://goo.gl/forms/8xLBqYqQjh22gpI42
Registrations will remain open until **15 December 2017**.

There will be no registration fee for this workshop. Limited travel and subsistence support will also be available for early career researchers (those who completed their PhD less than eight years ago, excluding career interruptions).
If you wish to request travel support, then you must register by 20 November 2017.

A circular will be available in early November with details about the schedule, venue, transport and accommodation options.

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Front cover photo:

The c. 100 m thick sedimentary package at Charyn Canyon, in far southeastern Kazakhstan, preserves an aridification sequence for Central Asia, grading from post-Tethys Neogene red clays into fluvial gravels, then alluvial fans and sheetwash deposits, and finally overlain by loess deposits.

The new Research Group for Terrestrial Palaeoclimate at the Max Planck Institute for Chemistry, led by Kathryn Fitzsimmons, aims to use a range of geochemical and geochronological techniques to provide quantitative data for past climatic conditions at this site in the rain shadow of the Asian High Mountains.
(Photo credit: Kathryn Fitzsimmons)

Georgina Falster coring birch on the tree line. See Reports (Photo credit: Georgina Falster)

EDITORIAL

Dear fellow Quaternarists,

"Neither Alan nor myself were prepared for what was to come. Not only were we in the presence of Australia's oldest human burial, but the mourners of that ancient occasion had left their indelible mark." (Jim Bowler, 2017)

Occasionally, we strike moments in our professional and personal lives that are turning points; not just in our own personal odyssey, but within the wider context of our nation and indeed, human civilisation. Jim Bowler and Alan Thorne experienced just such an epiphany, while excavating in the Willandra Lakes Region on February 25, 1974. Careful excavation of some lunettes at Lake Mungo revealed remains of an adult male, sprinkled with red ochre. Now dated at 40,000 yr (40 ±20), this is probably one of the earliest known examples of a sophisticated burial ritual in Australia. Mungo Man's discovery followed that of Mungo Lady in 1969 (by Jim Bowler) which also indicated ritualistic burial rights and mourning rituals.

These and subsequent archaeological findings in this area are significant, as they indicate that human occupation of the Willandra Lakes area dates back to around 50,000 years, and contributed to our greater understanding of the diaspora of modern humans out of Africa. So, November 17, 2017 marked a significant moment as Mungo Man was repatriated back to Lake Mungo, to remain with Mungo Lady, with the agreement of the traditional owners. In his report in this issue of *Quaternary Australasia*, Jim Bowler outlines the background to these discoveries, and also the significance of the cultural, natural and scientific heritage value of the Willandra Lakes area. This is the interdisciplinary space between archaeology, geosciences and geography that is embodied by AQUA – as noted by Scott Mooney in his President's Pen in this issue.

We also report on other research initiatives: the SHAPE special issue of Journal of Quaternary Research has been published; and SHeMax has run a recent productive workshop in Wellington, to be followed by another in Wollongong in February 2018. Helen Bostock reports from the 12th International Conference on Paleooceanography in Utrecht, Netherlands. Kat Fitzsimmons reports from close to the Continental Pole of Inaccessibility – during a 6 week field expedition to the Tian Shan piedmont area of southern Kazakhstan to examine paleoenvironmental change in this arid part of central Asia.

Encouraging ECR's in their developing their skills is an important part of the professional development for scientists. Georgina Falster reports from 2 week workshop (Advanced Climate Dynamics) in Rondane National Park, Norway; while Haidee Cadd reports back from a quantitative vegetation modelling workshop in Greifswald, Germany. Our Editor, Sanja van Huet also reports from the recent CAVEPS conference in Queenstown, NZ.

We continue our exploration of science communication in this issue; Bob Wasson offers some personal reflections on his experiences of the place of science communication and how it can influence decision making.

Our next AQUA conference will be in Canberra in December 2018. Planning is well underway and we look forward to this biennial mustering of Australasian researchers and an opportunity to explore the Quaternary landscapes of the Canberra "environs".

WARNING: Aboriginal and Torres Strait Islander readers are warned that this issue contains images of deceased persons.

Yours Quaternarily,

Carol Smith and Sanja van Huet

Editors

PRESIDENT'S PEN

As a young person exploring postgraduate options I visited ANU. I was absolutely astounded by their Department of Biogeography and Geomorphology, as that disciplinary combination embodied many of things that I was, and still am, interested in. (That name no longer exists but these themes continue with the ANU Department of Archaeology and Natural History, which adds another great interest of mine, human history and human impact.) I guess I wrap up all of these interests these days in the simple phrase Quaternary science. This inter-disciplinary space between archaeology, geography and other geosciences, embodied by AQUA, provides an intellectual home that still stimulates and astounds me almost 3 decades later. The latest enormous, pleasant surprise for me was the ~65,000 year old basal date for cultural artefacts at the Madjedbebe site in the Northern Territory. It is always great to see our science in the news. Questions regarding the timing of when humans left Africa, the human colonisation of Australia and of human impacts all have global implications. My sincere congratulations to everyone involved in these amazing findings.

At our May 2017 AGM we discussed the location for the 2018 AQUA Biennial Meeting. In a vote, Canberra/Snowy Mountains received an overwhelming majority (and the support of some of the proponents of the rival bid!). Support for Canberra was probably also helped by new direct flights between Wellington and Canberra, and personally, I am happy for any opportunity to visit the high altitude environments of Kosciuszko National Park and the ACT. The proposed dates are the 10-14 December, 2018. Stay tuned for an AQUA list announcement for more details.

I hope you all have an enjoyable (austral) summer.

Scott Mooney *AQUA President*

MEET A MEMBER OF THE AQUA EXECUTIVE COMMITTEE

EMILY FIELD, AQUA SECRETARY

I am completing my PhD in the School of Earth and Environmental Sciences at the University of Queensland, with only a few months to go! Being a Pom, I initially did my B.A. in Geography at the University of Oxford, before falling in love with palaeoecology and going on to complete my M.Sc. in Quaternary Science at the University of London.

Emily Field with Sam Marx (Photo credit: Emily Field).

After my M.Sc. I soon tired of the UK's dreary climate and left for Queensland's sunnier shores. Having initially only intended to stay for a year doing backpacker-type things (think fruit picking and travelling up the East Coast), I accidentally got a job as a geologist in the Bowen Basin, and then also accidentally met a nice Australian and got married. So, after a stint doing FIFO work and even a small period working in real estate (yes, really!), I saw the perfect PhD at UQ, where I have spent the last ~3 years investigating climate and environmental change in the Kimberley. I use organic spring deposits as archives which are pretty unusual environments to come across in inland Australia, and they certainly don't come without their problems. A lot of my PhD has therefore also been involved with working out how we can use these types of settings (especially with how we can build robust chronologies for them), because they are pretty handy in arid and semi-arid regions where there aren't many perennial wetlands/lakes.

In my spare time, I try and go camping and four-wheel driving as much as possible, mostly on one of the many sandy beaches that surround us in South East Queensland (with Moreton Island being my top pick). I also enjoy running, hiking, and collecting rescue dogs (I have a particularly nice one available for adoption at the moment if you are looking!).

NEWS

SPECIAL ISSUE OF JOURNAL OF QUATERNARY SCIENCE

August 2017, Volume 32, Issue 6 Pages 661–901

This special issue of JQS, edited by Drew Lorrey and Rewi Newnham is now available. This compilation of 16 papers is a contribution to The Southern Hemisphere Assessment of PalaeoEnvironments (SHAPE) initiative. SHAPE builds on the significant achievements of INTIMATE in the Southern Hemisphere, with the aim of continuing to develop new palaeodata series within the framework of defensible chronologies and robust interpretations of records of environmental change, from 60ka to present. SHAPE has also aimed to foster increased spatial coverage; with regional palaeodata integrations and Quaternary science participation from South American, South African and Pacific Island researchers. In addition, the inclusion of emerging records from the Southern Ocean and Antarctica as well as the encouragement of early-career researchers were also aims of the project. Projects associated with SHAPE IFG include both Southern Hemisphere Last Glacial Maximum (SHeMax) project; and Southern Westerly Winds Evolution in the Past (SWEEP) project.

Andrew M. Lorrey and Rewi M. Newnham (2017). Late Quaternary records and chronology of environmental change in the Southern Hemisphere – a contribution to SHAPE. *Journal of Quaternary Science*, 32, 661-664.

CALL FOR SUBMISSIONS

FOCUS ON CARBON CYCLE DYNAMICS DURING EPISODES OF RAPID CLIMATE CHANGE

By Katrin Meissner

I would like to draw your attention to a new ERL Focus Collection on "Carbon Cycle Dynamics During Episodes of Rapid Climate Change". The guest editors Ed Brook, Sarah Finkelstein, James Rae and myself would be delighted if you could contribute a research article to this special issue (see flyer attached). The nominal dates for submissions are from now until 15 June 2018.

Katrin Meissner, University of New South Wales
Sarah Finkelstein, University of Toronto
Ed Brook, Oregon State University
James Rae, University of St Andrews

For more information:

http://iopscience.iop.org/journal/1748-9326/page/Carbon-Cycle-Dynamics-Climate

BOOK ANNOUNCEMENT

Philip Hughes, HEH Pty Ltd, PO Box 97, Moruya, NSW 2537.

Jack Golson, Tim Denham, Philip Hughes, Pamela Swadling and John Muke (eds) 2017. Ten Thousand Years of Cultivation at Kuk Swamp in the Highlands of Papua New Guinea. Terra Australis 46, Canberra: ANU Press

This book has much of interest to Quaternary scientists. It is a landmark publication as it presents the findings of over 50 years of research into early agriculture in the highlands of Papua New Guinea. The archaeological site at Kuk Swamp contains evidence of cultivation practices and agricultural innovation extending back to 10,000 years ago. The site is one of the most important archaeological sites in the equatorial western Pacific and represents the earliest evidence for agriculture in the region. It is now accepted that New Guinea was a major region of early independent development of food production. In recognition of its importance, in 2008 Kuk was accepted onto the World Heritage List, the first such site in PNG.

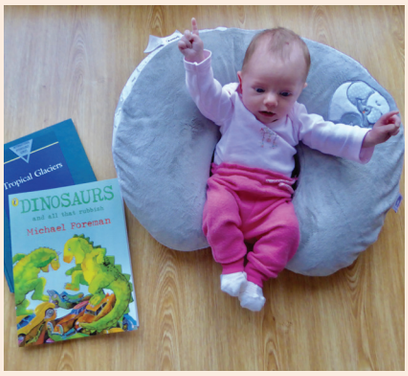
Chapters 6 (Geomorphology and Stratigraphy), 9 (Palaeoecology) and 10 (Archaeobotany) detail the natural and anthopogenic environmental history of Kuk Swamp and the surrounding regions over the last 50,000 years. Chapter 7 (Volcanic Ash at Kuk) describes the rich tephra sequence in the swamp, the origin and age of the tephras and their chronostratigraphic importance. Chapter 8 (Tibito Tephra, *Taim Tudak* and the Impact of Thin Tephra Falls) examines the impact of the last major tephra, Tibito Tephra, in the AD 1660s, on people, housing, crops and animals.

Chapters 11 to 16 describe the six phases of swamp drainage and cultivation, the major agricultural innovations that occurred over time in the swamp and on the surrounding dryland, and their impact on the local and regional environment. Possible reasons for swamp abandonment and re-use are examined, including the influence of tephra falls, El Niño droughts, the Mediaeval Warm Period/Little Climatic Optimum and the Little Ice Age.

You can download a free pdf copy of the book or order a hardcopy at: http://press.anu.edu.au/publications/series/terra-australis/ten-thousand-years-cultivation-kuk-swamp-highlands-papua-new

BIRTH ANNOUNCEMENT

Isabelle Margaret Barrows was born at 05:12am weighing in at 3.1 kg on 29 September. Mother and baby are doing well.



ERRATUM

Please note that the June 2017 Article "Vale Ignacio Martinez" was wrongly attributed to Helen Bostock. It was in fact written by Patrick De Deckker. We sincerely apologise for this error and we thank Patrick for his contribution to *Quaternary Australasia*, commemorating Ignacio's life.

MUNGO MAN'S RETURN: NEXT STEP IN A LONG JOURNEY

Jim Bowler [a] and Jessica Reeves [b]

a Retired

b Faculty of Science and Technology, Federation University of Australia, Churchill, VIC 3842, Australia.

WARNING: Aboriginal and Torres Strait Islander readers are warned that this article contains images of deceased persons.

I. INTRODUCTION

Moments that change the destiny of the nation's heritage are few and far between. One such occasion arose in 1982 when John Mulvaney successfully proposed the inclusion of the Willandra Lakes on UNESCO World Heritage register. With imaginative anticipation, he insisted on nomination under joint categories of Natural and Cultural Heritage. Thirty-five years later history has justified the decision. John's death, September 2016, has marked the end of an historical chapter in the Willandra Lakes' history.

By the time this journal goes to press, Mungo Man, after 43 years in waiting, will have been returned home (on 17 November). It is timely now to reflect on these and subsequent events. Big changes are on the way! John's death in the close of one phase has, with the return of Mungo Man, defined the beginning of another.

II. REPATRIATION ARRANGEMENT

In its return to Lake Mungo, Mungo Man's casket will remain with those of Mungo Lady by agreement of the traditional owners (Barkantji, Maurara, Mutthi Mutthi, Ngiyampaa, Paakantji and Parintji tribal groups).

Early *"who owns history"* confrontation between scientists and traditional owners on Lake Mungo shores in the late 70's set the scene for more intense dialogue between cultures. In 1989, that dialogue between science on one hand, traditional owners on the other, defined an historical agreement to collaborate with and learn from each other.

A Plan of Management, *Sustaining the Willandra 1969*, defined committee arrangements for future developments. Under the guiding hand of Mr Mike Ockwell, Chair of Community Management Council, positive momentum was achieved. Since Mike's retirement in 2013, a temporary advisory committee has been in place. A new formal committee is currently awaiting final ministerial approval before appointment.

In 2014, the then newly created NSW Office of Environment and Heritage established an Indigenous Repatriation Committee under traditional owners to arrange return of all skeletal remains. That group, in wider consultation, successfully delivered their objectives. They defined the arrangements for Mungo Man's November return to Lake Mungo shore. That moment of return is one of great celebration.

III. TREASURE STATUS

What of Mungo Man when he comes home?

What exactly can we expect from the special qualities of Lake Mungo burials, of Mungo Man in particular? The long-term future of those remains must be consistent with the treasured value they represent. It is timely to recall some details.

On February 25th, 1974, the remains that attracted my attention on the southern, Joulni sector of Lake Mungo lunette, immediately required the presence of Alan Thorne. A recent physical anthropology appointment in Jack Golson's ANU Department of Archaeology, Alan arrived with his excavation team virtually next day!

Neither Alan nor myself were prepared for what was to come. Not only were we in the presence of Australia's oldest human burial, but the mourners of that ancient occasion had left their indelible mark (Figure 1). Details are worthy of record.

GRAVE SUMMARY

- Located on southern, lee side of shoreline dune
- Rectangular form about 1 m deep into soft dune sands
- Inserted through dark soil with layer of pelletal clay, recent dry phase in lake
- Orientation NE-SW, slightly oblique to main E-W dune axis
- Body laid out horizontally, lying on right side, hands clasped across groin
- Ochre anointing, painted on body or heavy sprinkling on grave
- Grave-side fire, cleansing or mourning ritual
- Grave infill, containing some clay pellets from surface layer.
- Renewed dune accretion eventually covered grave by some 4-5 metres
- Stable period, soil development cemented bones by secondary carbonate.
- Post-European arrival, accelerated erosion strips off dune cover
- 1974 discovery of emerging cranium on erosion surface

Dated at 40,000 years ago (40±2ka), Mungo Man's burial rituals rate high on the Richter scale of humanity's cultural expression. Worthy of any cathedral requiem, they were enacted here on the cathedral shores of Lake Mungo 36,000 years before the biblical patriarch, Abraham.

Figure 1. Late February 1974; Dr Alan Thorne in excavation mode during removal of Mungo Man's remains found by Jim Bowler just 2 days previously on the Joulni segment of the Lake Mungo lunette (Photo credit: Jim Bowler).

These are issues without equal anywhere in the world. In the words of Tom Keneally:

"It is both very human and very Australian to have a treasure before us and not know what to do with it, or not even know it's a treasure. .... Mungo Man's return... gives our entire community, black and non-black, a new bond and a national glory.

Tom Keneally, The Age, April 26, 2016

IV. RESTORING NATURAL HERITAGE

The story of Mungo Man has involved three successive stages:

Stage 1. From his ritual burial 40,000 years ago until 1974.

Stage 2. 1974 until 2017, his return to visibility, while retained for 43 years in the service of science in the ANU and temporary storage in the National Museum in Canberra.

Stage 3. Return to Lake Mungo shores, welcomed by Aboriginal descendants, November 17, 2017.

With return home end of stage 2, we face responsibility to define options for the third stage. In its successful completion of 43 years (Stage 2), the final outcome owes much to the collaborative example established 30 years ago on Lake Mungo shores. What began in that historical 1987 agreement between elders and working scientists awaits its next stage evolution. Where people of both cultures learn to work with and learn from each other, that process involves a common bond with both land and people. It acts as an example for that wider cross-cultural communion the nation so urgently needs.

Thus far, while decisions have involved detailed consideration of Cultural Heritage, the Nature component now awaits its delivery. That process involves completion of that Nature-Culture union, a new synthesis of Land and People, the very basis of World Heritage inscription.

When Nature merges with Culture, two things happen. The Rational encounters the Intuitive, Science encounters the Dreaming. Both are changed, something new is born. That now necessary conjunction poses an entirely new agenda.

We may note some brief components of Natural Heritage that await their rightful inclusion in the bigger picture:

- Understanding lunette and salt lake formation.
- Climatic change: Ice Age story of landscape evolution.
- Humanity's climatic legacies: from Origins in climatic change to Agents of change
- Records of such change in Murray Basin dunes, rivers, general system understanding.
- Mungo to Naracoorte, Murray Basin correlations with African hominid origins
- Natural context of human habitation.
- Extinctions, human impacts

V. A NEW DYNAMIC

The Nature-Culture union offers a new dynamic, a spirit energy linking us all to our Gondwana origins. Expansion of the Nature component necessary for that union stands as a challenge to deliver these basic objectives.

Lake Mungo in particular, and the Willandra World Heritage area in general, provide ingredients for that union of Land and People confronting visitors with a new paradigm. It is one far removed from urban commerce. It challenges us to embrace a sense of empathy, a new bond between land and people. In that context, we deepen our own understanding of who we are in this remarkable land with its equally remarkable people.

It is an issue of special relevance to AQUA members where the stories of land integrate with stories of people. The future of the Willandra Lakes World Heritage Area awaits delivery of those integrating stories. What John Mulvaney began in 1982 awaits our completion.

QUATERNARY SCIENCE, HUMAN AND ENVIRONMENTAL HISTORY, AND PUBLIC POLICY: SOME PERSONAL REFLECTIONS

Bob Wasson

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ABSTRACT

Communication to the general public of the significance of our research is a crucial role for Quaternarists. Those who wish to communicate widely may also wish to influence decision-making. It is to this last objective that I have devoted a considerable portion of my career, with mixed results. In what follows I provide a set of personal experiences and reflections contextualized by reference to a published account of the nature of evidence-based policy making and another on the ways in which scientists can present themselves to policy makers. I conclude with suggestions for those who wish to influence policy.

1. EVIDENCE AND POLICY MAKING

Petherick and Hall (2017) have done a service to the Quaternary community by setting out the key issues of communicating our science to the general public, although they also touch on communication with decision makers. But science not only informs the public; it can also help to solve problems identified by politicians and public servants, and also identify problems.

While contributing to the basics of geomorphology and Quaternary studies I have also focused on influencing government decision-making and aiding the implementation of decisions. To me, Quaternary studies have similarities to human history and environmental history. Therefore, I give weight to all forms of historical inquiry that aid our management of natural resources. I also do not distinguish between decision-making and policy-making because some critical decisions do not need a change of policy and all policy-making requires decisions.

Most scientists are likely to accept that Evidence-Based Policy Making (EBPM) is desirable, although another related concept has gained salience, namely Evidence-Informed Policy Making (EIPM). While EIPM may more accurately capture the role of science in policy making, the two concepts can also be confusing because the difference between EBPM and EIPM is not always clear. Much has been written about the topic of EBPM, and Cairney (2016) has provided a particularly useful summary and interpretation of much of the relevant literature, an account of the political process that is public policy making, and the various roles of scientific evidence in that process.

Based on Cairney and my own observations, I offer the following. EBPM is not a description of the policy process. It is an aspiration that fails to acknowledge that evidence is only one component of policy making, and often a minor component. Policy makers have to take into account a myriad of considerations. These include identification of the winners and losers, the likelihood of successful implementation, the political milieu in which they are embedded, the costs and benefits of a policy, the dovetailing with other policies, the reliability of scientific evidence in relation to other sources of information such as that coming from community members, and how best to communicate the policy to stakeholders. Policy makers operate in a world of considerable uncertainty and ambiguity, but have to make choices about the highest priority issues. Scientific knowledge can reduce uncertainty but may not be able to reduce ambiguity (see Wasson, 2016, for an example in flood hydrology), and may in some circumstances aid prioritization.

But who are public policy and decision makers? Cairney (2016) makes the important point that there are many people who fit this description, and the idea of centralized decision-making power in the executive of a democratic system is an over-simplification. There are many policy makers at different levels of government, with influence and/or decision-making power. There are also advocacy coalitions, containing policy makers and communities of interest outside the formal policy-making process, which may have different interpretations of the same evidence, and of the world. These interpretations can change, for example after a new government is elected or a focusing event (a window of opportunity for scientists and policy-makers disposed to take their input seriously) occurs. Such an event may be an ecologic disaster or the signing of an international agreement that requires a policy response.

Many scientists claim that policy makers often ignore evidence or don't use it effectively, by which they usually mean that it doesn't have the overwhelming influence that they believe it should. In addition, they also have a view that politics is pathological because it doesn't use evidence at all and they cannot understand why their evidence is not the only basis for a rational policy choice, forgetting

or ignoring all of the other factors that policy makers have to consider. Some scientists may tend to view their work as being superior to all other forms of information, something that is not necessarily accepted by policy makers who often have to take account of community views and expectations. In the minds of some decision-makers science is not necessarily more certain than other kinds of information, even though it is produced by a method that is claimed to be superior because of inbuilt checks and balances. But science will only have overwhelming influence if policy is being constructed in the mode of 'comprehensive rationality' in which policy makers have a clear set of preferences, and they can gather and understand all the relevant information and make choices based on that information; a very rare mode of policy making. Much more likely is the mode of 'bounded rationality', where aims are unclear, there is limited information, and unclear choices.

Major obstacles to EBPM and EIPM are many. Much academic research has no policy relevance but is thought by academics to be valuable nonetheless, while some will press their view in the face of disinterest and even hostility. Academics often do not know how to use their networks with policy makers and relevant policy makers are often not identified within an often diffuse array of decision making. Timely engagement often does not happen and advice is not provided in a timely fashion, while evidence is not framed or presented in a language to meet policy makers' aims. Sometimes there is little attempt to involve policy makers in research and therefore limited 'ownership' of the results. There is poor recognition that policy is usually designed for the short term and that community acceptance of scientific evidence can add legitimacy and political value. Moreover, the beliefs of policy makers may be at odds with scientific evidence and so need to be carefully debated without arrogance. Academics, and some technicians in government departments, produce unrealistically long 'laundry lists' of problems and putative solutions without prioritization; so-called 'wicked problems' require knowledge from many disciplines, something that is still a major challenge for academic and research institutions.

It is therefore important to identify the key actors (including government departments) in a policy making environment, understand the policy networks at play and therefore identify where power lies, gain some understanding of the political, social and economic context in which decision making is occurring, and discover the most urgent problems that need a policy response and frame evidence accordingly.

So, policy-making is a very complex business. Sending a scientific report to a Minister's office, for example, and then waiting for a policy response is unlikely to be successful. But if scientists wish to have influence on policy-making they must learn something of how policy is made. This can be time-consuming, frustrating, unsuccessful, and sometimes rewarding, but is not something to be embarked on lightly. And it shouldn't be a path for all Quaternarists, especially those in the early stages of their careers whose focus should be on establishing their scientific credibility. However, over recent years I have noted that more young scientists wish to be in the policy fray, a trend to be supported by more established scientists (if they have the appropriate experience) who can team up with young scientists to influence policy. Some research organizations employ 'knowledge brokers', a step that can reduce the burden on practicing scientists and aid the link to policy making.

Another way to be of value to policy makers is to review large amounts of relevant literature and data, an activity best done by established scientists. Most policy makers rely on personal experience and expert advice rather than systematic reviews of the literature. A credible review can therefore be of value when the right moment arrives, and can be published to add to a scientist's CV.

In my view, it is essential that if a Quaternarist takes the path of engagement with policy makers he/she should maintain their science simultaneously, so that they are up to date, credible, and not so professionally isolated by unsuccessful attempts to influence policy-making that they have nothing to fall back on. I realize in these days of citation counts, H-indexes and all of the other paraphernalia of the neoliberal university and research institute (Busch, 2014) that this is a lot to ask; so step carefully.

2. WHAT ROLE DO YOU WISH TO PLAY?

While not without his critics, Pielke (2007) presents a typology of the roles that scientists can play (or not play) when connecting with policy and politics. In summary Pielke identifies four possible roles. The first is the Pure Scientist who focuses on knowledge generation without direct connection to policy and politics. Knowledge is made available for anyone to use through publication in scientific journals and books. The second is the Issue Advocate who aligns herself/himself with a particular cause, accepting that science must be engaged with decision-making but offers only one or a few policy options. They also publish their research thereby making it available to all who wish to access it. The third type is the Science Arbiter who aids decision-makers wrestling with problems and the evidence they wish to use to reach a conclusion. Generally Science Arbiters focus on questions that can be answered by science, and remain

above the political fray. The fourth type is the Honest Broker of Policy Alternatives who clarifies and even expands the scope of policy choices well beyond those offered by the Issue Advocate. This type usually do this as part of a group because to range over a wide range of options is difficult for an individual. Pielke notes that a diversity of policy options avoids issue advocacy.

Scientists can play several of these roles at different stages of their careers or even simultaneously for different issues, a difficult balancing act. Some will appear to be playing one role while really playing another. The most common is the Pure Scientist who is actually, in Pielke's (2007) language, a Stealth Issue Advocate. This role has the advantage of appearing to be above the political fray, wrapped in the credibility and apparent objectivity of science, while stealthily providing evidence to advance a particular policy option. All four roles can be valuable, but it is important for the individual to clearly identify which one(s) they wish to adopt. Clarity of role and purpose for the individual will be helpful if challenged, for example if called before a Parliamentary inquiry. I have mostly played the role of Honest Broker; at least in my mind.

3. SOME PERSONAL EXPERIENCES AND REFLECTIONS

Here I am in danger of appearing to be egocentric. But I believe that by presenting my own experiences in a highly personal form I can communicate more effectively. I also need to provide some context for my career, an indulgence that I hope you will accept.

A. CATCHMENT MANAGEMENT

After a postdoc in New Zealand, a teaching position at Monash University when I began to reacquaint myself with the Australian desert dunefield, and a research fellowship at ANU where I launched a 'blue sky' project on the history and morphodynamics of the Australian and Indian desert dunefields, I joined CSIRO in 1982, having responded to an advertisement for a position to analyze how, through time, Australia's environment had reached its current state.

The first major project at CSIRO came about by invitation from the NSW and ACT authorities responsible for catchment protection, with the aim of determining the sources of sediment that was believed to be filling Lake Burley Griffin in Canberra. I was asked to advise the New South Wales Soil Conservation Service (SCS) on how to target their efforts to reduce sedimentation in the lake. I collaborated with key people in the SCS and the ACT equivalent. We did fieldwork together and published together (Wasson et al., 1998). We calculated a quantitative sediment budget for a major sub-catchment that involved morpho-stratigraphy, historical documents, and did a lot of ground survey including estimating the amount of sediment beneath the very cold water in farm dams to determine sub-catchment sediment yields. The Quaternary component involved a history only a few centuries long (although it was contextualized by reference to Holocene and Late Pleistocene stratigraphy) that at the time was not considered to be mainstream Quaternary research.

The conclusion, subsequently confirmed by using geochemical tracers, was that channels and gullies are the dominant sources of the sediment in the lake. In a comprehensive account of the project, the New South Wales Department of Land and Water Conservation (2000) acknowledged that, although there had been recognition of serious riverbank and gully erosion from 1969, it was our work that allowed the SCS to refocus the soil conservation program onto the major sources of sediment. Many methods were used to stabilize the sediment sources, such as gully infilling and smoothing, flumes to divert water from gully heads, farm dams, and banks along channels and gullies, fencing and revegetation. Some attention was also paid to reducing sheet and rill erosion on farmland as the economic viability of the farmers was also of concern. A subsequent program called Bidgee Banks focused on fencing and revegetation of riparian zones (http://www.riverspace.com.au/item/bidgee-banks/; accessed 2 October 2017), a policy that has become widespread in Australia, although I am not trying to take credit for its spread. That said, I advised many catchment management groups and government agencies around the country based on the Lake Burley Griffin catchment study and other similar studies done by the CSIRO group.

The lessons I gained from this experience are as follows: focus on a problem that is exercising the minds of decision-makers; involve decision-makers in the research, or at least those who influence decision makers; talk to community groups to share the results of the work and build an advocacy coalition; use all relevant information and approaches, for example geomorphology, geochemistry, human and environmental history, and Quaternary studies; make links to the scientific understanding of collaborators, in this case soil erosion processes; and provide timely input to catchment planning (Wasson et al., 1989). All of these lessons can be found in Cairney's (2016) account of how to influence decisions, with the exception of the second last, although Cairney had not written his book when most of our work was done.

With colleagues at CSIRO I continued this work having discovered that ^{210}Pb(ex) is not only a chronometer but is also a tracer of surface soil (Wasson et al., 1987). Application of this technique to the sediments in Burrinjuck Reservoir, downstream of Canberra, showed that over the past 60 or so years the major sources of sediment had changed from a considerable input of surface soil, during the rabbit plague, to subsoil via gully and channel bank erosion as rabbits were controlled, farming practices improved, and sheet and rill erosion rates declined. Also, the sedimentation rate in the reservoir had declined through time, a conclusion seized upon by some catchment managers to show that soil conservation was working. I had to offer the disappointing view that, while their conclusion was likely to be partly true, gullies and channels had begun to stabilize of their own accord. Many Quaternarists would not view reservoir sediments as a likely target for their endeavours, but in these days of high resolution studies reservoirs are fabulous archives; albeit for short time periods.

At the invitation of the Western Australian Department of Agriculture, a group of us at CSIRO studied the major sources of sediment reaching Lake Argyle in the East Kimberley (Wasson et al., 2002) using the methods applied in the catchment of Lake Burley Griffin, including geochemical tracers and mineral magnetics. The temporal component included determining the ^{137}Cs content of cores taken from the lake sediments from which, with some other inputs, Andrew Murray was able to calculate a ^{137}Cs budget for the entire catchment, and also by using the ^{137}Cs content of recent in-channel alluvial benches to determine a history of surface soil input to the river and lake. Once again, I ensured that we were working with key decision-makers and we involved government staff in the research.

Because the Department had concluded that sheet and rill erosion was the main source of sediment, given that in places 30cm had been removed since the introduction of cattle, a herculean effort had been mounted before our research began to slow sheet and rill erosion by contour bank construction and revegetation. Our results however showed that once again gullies and channels were the major source of sediment. The Department concluded that the land they controlled was not valuable enough to stabilize so they destocked it after exterminating a vast number of feral animals. We also carried out a spatial source tracing study, based on sub-catchments, which enabled advice to be given to pastoralists in all parts of the catchment. The lessons from this experience were the same as those learned from the case of the Lake Burley Griffin catchment study. Our work had been appropriately targeted, key decision-makers 'owned' the results, the conclusions were credible, and our reporting timely. I also spent some time explaining our results to land owners, a potentially hazardous experience given that one of the properties that was yielding most sediment was owned by one of the largest men I have ever met! But he was a gentle giant.

By now you will have the view that I was fixated by this kind of study, and you would be correct. We were also beginning to wonder if our techniques were valid so we decided to explore the Darling Downs in Queensland where surely sheet and rill erosion dominate the sediment input to rivers. An unpublished Honours thesis showed that surface soil dominated the sediment flux upstream of gully heads but within a few metres downstream of these heads subsoil from gully erosion dominated. An unpublished PhD project came to the same conclusion in the NSW wheat belt. Neither of these studies included a Quaternary component.

In the Daly River catchment in the Northern Territory a community based catchment management group, wonderfully named DRMAC (Daly River Management Advisory Group), asked for a report on, you guessed it, sediment sources because local Indigenous groups had reported sedimentation of the channel after land clearing for agriculture and tree plantations. We concluded that channel widening was the major source of sediment in the river (although there are some spectacular gullies) as a result of increasing rainfall and river discharge (Wasson et al., 2010). Clearing had had almost no effect, even though rates of sheet and rill erosion were high. In-channel benches, consisting of flood couplets, were dated by OSL and the surface soil tracers ^{137}Cs and ^{210}Pb(ex) were determined in the bench sediments to provide a longer history of surface soil input to the river, the results of which confirmed a one-off sampling of recently deposited mud. From analysis of the benches we also determined that they began to form about 500 years ago, that flood frequency was increasing along with sedimentation rate, and that the benches are now being destroyed as the channel widens. This appears to a consequence of a low frequency climate oscillation documented in swamp sediments in Kakadu National Park (Wasson, 1992).

By the time this research was complete and a report prepared (Wasson et al., 2014), DRMAC had been dissolved (http://www.abc.net.au/news/rural/2013-07-31/drmac-canned/4855998; accessed 1 October 2017). Had we moved faster we could have influenced a well-regarded community group. But we failed because, as Cairney (2016) sternly warns, we did not provide timely advice.

The then Office of the Supervising Scientist for the Alligator Rivers Region (OSS) wanted to know what would happen to the wetland downstream of the Ranger uranium mine in Kakadu National Park should the mine mill tailings escape; part of a wide-ranging risk assessment. Most of our research in response to an invitation from the OSS was based on a study of the Quaternary history of the wetland (Wasson, 1992). We decided to work out where natural sediment, originating from the catchment upstream of the mine, is deposited in the wetland, as an analogue for deposition of the tailings. While there were well measured suspended sediment fluxes for some of the rivers in the area, there were insufficient data to estimate the patterns and rates of deposition in the wetland. Many cores, pollen analysis by Robin Clark to determine the base of the freshwater section, and dating by ^{14}C and ^{226}Ra(ex) provided the pattern of sediment deposition in the wetland. Then Ian Willett from CSIRO Division of Soils experimentally added tailings to samples of the natural deposits in the wetland to determine the chemical mobility of the pollutants. In this case we were working directly with the decision makers to meet their objectives. Our report is still being consulted as the final arrangements for stabilization of the tailings are being made.

B. EXTREME FLOODS

Since experiencing the 2003 bushfire in Canberra and several tropical cyclones bearing down on Darwin, and with an abiding interest in the yet unresolved issue of the magnitude of processes that do most geomorphic work, I became involved in disaster research. I have focused on flood disasters in Asia since coming to Singapore. Given that I am not a native of any Asian nation, I have had to build links with decision makers, some of which I had from previous projects.

With my colleagues at the National University of Singapore (NUS) and in India I began by establishing scientific credibility by producing long flood histories in the Himalaya (Wasson et al., 2013) and northern Thailand (yet to be published) using OSL and ^{14}C dated palaeoflood deposits, within the context of a critique of traditional flood forecasting approaches (Wasson, 2016). This has provided a platform from which to organize workshops on Flood Disaster Risk Reduction (DRR), an approach agreed to by many nations under the Sendai Framework (http://www.unisdr.org/we/coordinate/sendai-framework; accessed 2 October 2017). In March 2017, under the auspices of the Indian National Science Academy in Delhi, my colleague Ashok Singhvi and I organized a workshop on flood DRR in India. The workshop produced a very impressive ('laundry') list of recommendations, all of which were sent to the major national Ministries in India with some responsibility for disaster mitigation. But without follow up with the Ministries, and prioritization of the list of recommendations, it is difficult to know if this activity will have much impact. The next step is to produce a paper for the Proceedings of the Indian National Science Academy with cross-referencing to a report from the Comptroller and Auditor General of India (2017) on the performance of national government programs for flood control and flood forecasting. By this means we hope to link our report to the highly critical findings of the supreme audit body of India, and therefore influence future decisions.

But DRR workshops may need to be more locally situated. To this end in September 2017 John Bray (an historian of Ladakh) and I helped to organize a flood DRR workshop in Ladakh (trans-Himalayan India) that was largely driven by local people from government, NGOs, and the academy. The Ladakhi academic charged with writing the latest version of the Disaster Management Plan for Ladakh has already adopted five ideas from the workshop. While this is the result of a heavy investment of time in finding the appropriate people to attend the workshop, and then helping with the logistics and discussion, it appears to have paid off by focusing on an issue of high local policy relevance, ensuring that Ladakhis drove the process, and including key Ladakhi decision-makers in the exercise. A similar workshop is planned for Assam in November 2017.

In Thailand, where we have (unpublished) evidence for a flood most probably in 1831CE that was possibly forty times larger than any flood recorded in Chiang Mai, and identification of key decision-makers in government and NGOs, two symposia/workshops have had little impact. It is not clear why this has been the case, but the scale of the mega-flood, and the two of similar size in the preceding 400 years, may have been overwhelming. It may be that they didn't believe us, or know how to respond to our results. Also, the style of the meetings may not have been appropriate, given that they were dominated by lectures by foreigners. Clearly we have yet to work out how best to engage with the flood managers in Chiang Mai.

4. CONTRIBUTIONS TO THE ACADEMY

Apart from my ongoing contributions to 'blue sky' geomorphology and Quaternary studies, and engagement with decision-makers, I have also written several papers and book chapters designed for academics interested in the role of history in the management and governance of natural resources, catchments and floods. The first attempt was by Wasson and Clark (1985) that unfortunately used the phrase 'environmental history' when we should have referred to 'history of the environment' given that environmental history is an account of the dynamic relationships between people and the natural world. Wasson (1994), Wasson and Sidorchuk (2000), and Wasson (2006a) took this further and attempted in the second paper to generalize a lot of research on catchment responses to disturbance, while the third paper attempted to synthesise various pieces of research in the context of environmental history *sensu stricto*. Wasson (2012) provided further insights into the use of history for catchment management, this time by compiling data from analyses using ^{10}Be. Wasson (2002) synthesized a large body of research on the Gangetic Plain to suggest that natural resource management could benefit from a spatio-temporal approach, and Wasson (2006b) ventured into the enormous span of South Asian history to ask if conservation has ever trumped exploitation of soils in a society that at least rhetorically celebrates a conservation ethic with phrases such as 'Hindu ecology'. The answer appears to be no.

With regard to flood governance, history is critical in several ways. Wasson (2016) has followed several other researchers by arguing that traditional flood frequency analysis (FFA) is flawed, particularly because it relies on short records of floods. To overcome this limitation, and to test the idea that short records are unlikely to include the truly extreme events, a lot of effort has been invested in palaeoflood research (particularly by Vic Baker, the University of Arizona, and his students) including that by Wasson et al., (2013). While there has been some use of palaeoflood hydrology in the USA, Australia continues to use the traditional methods.

Newell and Wasson (2002) argued for a use of history in system dynamics approaches to flood governance, an idea now being explored in Assam to attempt to understand current flood mitigation policies and their origins. This research is based mainly on human and environmental history, but there is a need for stratigraphically-based Quaternary research. The construction of embankments to afford some protection from floods may have reduced the amount of sediment reaching floodplains so eventually the aggrading channel of the Brahmaputra River may rise higher than the floodplain. Sedimentation rate changes both on the floodplain and in the channel are needed, requiring high resolution dating and stratigraphy.

5. CONCLUSIONS

From my own experience, and the syntheses of Cairney (2016) and Pielke (2007), I suggest the following. Begin by identifying urgent problems that have been identified within a decision-making environment and to which you can contribute. Try to understand the policy-making framework within which decisions will be made, and identify the key people with whom to work. Frame your contribution in a form and language that the key people can use, and provide timely input in a way that is agreed upon in advance. Make the uncertainties of your input clear, so that realistic assessments can be made about the veracity of your science. Use as many research tools as you can, including Quaternary methods, human and environmental history, and process understanding so that your work is not too narrowly focused and is therefore more likely to be successful. If policy options can be provided, ensure that the list is not too long and is prioritized, with estimates about likely success. If you cannot do all of this yourself, team up with other scientists. If you want to get your message to a larger audience, and the political risk of doing so is acceptable, build coalitions of advocacy among for example community groups. Be clear about the role that you are playing, the default role to me being the Honest Broker. Accept that you may be a small cog in a large machine, that most policies are designed for the short-term, and that sometimes your input will be ignored. If you want to stay in this game, try to stay positive even after a failure. The rewards can be exhilarating. And maintain your scientific credibility.

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HANGING OFF CLIFFS IN CENTRAL ASIA OR, A FIELD CAMPAIGN IN SOUTHERN KAZAKHSTAN

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Central Asia lies at the core of the largest and most populous continent on Earth – Eurasia – however we know little about its role in global climate dynamics past and present. Long sequences of primary loess (aeolian dust) and buried soils blanket the mountain piedmonts of Central Asia and reflect responses to past climatic change over at least the last million years. Central Asia and its extensive loess deposits are notably sensitive to the interplay between the powerful climatic drivers; the north Atlantic westerlies, the polar front and the Asian monsoon. Ongoing uplift of the Asian high mountains (the Himalaya and Tien Shan, among others) has affected the climate of the central Asian basins to the north through time, driving aridification and continentality. In spite of its key position in the northern hemisphere climate circulation systems, however, the climatic history – and trajectory – of arid central Asia remains largely unknown. Our new group aims to improve our understanding of climate dynamics in the terrestrial zone, by generating high resolution palaeoenvironmental records embedded within robust chronological frameworks.

Kazakhstan lies close to the continental pole of inaccessibility, as far as one can get from the oceans, which, for our research group, is precisely the point. Our aim is to generate quantitative data for past climates over the last few million years for the continental inland region of Central Asia, comparable with the high-quality records provided by the oceans and ice cores.

In May-June 2017 we completed our first major field campaign, sampling sediment records along the northern piedmont of the Tien Shan mountains in southeast Kazakhstan (Figure 1). Our expedition to the steppe involved 14 scientists, a professional mountaineer, 250 m of climbing rope and several dogs who adopted us on our fieldwork. A local shepherd tried to convince his horse to help us carry the equipment but the horse turned the opportunity down (not before some of us got to ride him, however – see Figure 2).

Our focus was on continuous sampling of sediment records at two sites. The first site, Remizovka, is a 25 m thick loess deposit in the centre of Almaty city (Figure 3), so quite handy from a logistical perspective (providing opportunities for daily showers and ice cream!). The second site, Charyn Canyon, was much more remote (Figure 1); it is an 80 m sequence of alternating river and loess deposits some 400 km eastwards towards the border with China. Since both sites are nice, thick vertical profiles (quite a contrast to the sediment-poor regions more common in Australia!), we needed to collect our samples using harness and ropes (Figure 4), which made for some scenic, if adventurous, sampling!

Figure 1. The aridification of Central Asia, preserved within the sediments: Charyn Canyon, with the snow-capped peaks of the Tien Shan in the distance. (Photo credit: Charlotte Prud'homme).

Figure 2. Friendly locals: Charlotte Prud'homme riding a shepherd's horse in the Charyn Gorge. (Photo credit: Charlotte Prud'homme).

Above: Figure 3. The uppermost 25 m at Remizovka preserves c. 130 ky of continuous loess accumulation. Sampling by abseil only. (Photo credit: Charlotte Prud'homme).

Left: Figure 4. Giancarlo Scardia and Kathryn Fitzsimmons discuss the finer points of palaeomag sampling at Charyn Canyon. (Photo credit: Kathryn Fitzsimmons).

Almost immediately upon arriving in Almaty – Kazakhstan's largest city, nestled in the shadow of the Tien Shan mountains – we set up the ropes at our first site. Remizovka is actually the site of a ski jump initially constructed for the 2006 Asian Winter Games in Almaty. Ski jump training continues into the summer, and so consequently, when we were lucky, we could bypass the substantial climb up the mountain and take the chairlift to the top! (Figure 5). Thanks to the construction of the sports complex, the loess hill has been sliced almost in half, rather like a dusty cake (Figure 3).

Nevertheless, before our sampling started we needed to clean back our profile to make sure no modern-day dust contaminated our old samples and to remove any large, unstable blocks of loess which were hanging over our sampling area (there were a few of these). After that, sampling began in earnest. Since we were safely strapped into harnesses, we could collect continuous samples – depending on the type of sample being collected, at 2.5 cm, 5 cm, 10 cm or 50 cm resolution – down the 25-m profile. We collected sediment to be analysed for grain size, magnetic susceptibility, pollen and phytolith assemblages, lipid and bacterial biomarkers and earthworm carbonate granules. These proxies will give us information about past wind regimes, temperature, precipitation and seasonality of precipitation, and will be placed within a chronological framework using luminescence and radiocarbon dating. Based on our knowledge of the site (Fitzsimmons et al., in press), the highest resolution samples will give us quantitative past temperature data over 125 year intervals, throughout the last 130 000 years – hopefully enough for us to identify links with large scale climatic subsystems such as the Asian monsoons or North Atlantic circulation patterns.

Our second major site, Charyn Canyon, provides us with an even longer sequence for reconstruction of past climates. This spectacular canyon, in parts 300 m deep, was formed by the incision of the Charyn River into sediments that have accumulated over the last several million years. The stratigraphy indicates that the landscape was initially dominated by enormous rivers, which developed into smaller braided streams and alluvial fans over time, and was finally blanketed by loess deposits forming the semi-desert surface today. This sequence reflects the progressive aridification of Central Asia as the Asian high mountains, including the Tien Shan, Himalaya and Tibetan Plateau, uplifted, so preventing monsoon precipitation from penetrating this region. We sampled an 80 m sequence, broken into three smaller sections, and including one rather adventurous 40 m abseil! (Figures 1, 4). The sediments here are much more consolidated and more carbonate-rich, and organic material is not so well preserved in this semi-desert environment, so we altered our sampling strategy accordingly – focusing mostly on grain size, magnetic susceptibility and soil carbonates for past environmental reconstruction, and palaeomagnetism and luminescence to provide the chronological framework. Pilot samples for biomarker proxies were collected, in case this material is preserved; should we obtain positive results, we will return to sample next year. It was tough work hacking into the sun-baked sediments under a 35°C sun, so we tended to start work early in the morning, take a siesta and continue into the early evening. Our living conditions were not unlike a field camp in the Australian desert, since there were no facilities in the national park, but with the addition of a portable banya (sauna) for relaxing in the evenings – apparently this is a camp staple in Kazakhstan!

Figure 5. A site with a view: Johannes Albert and Kathryn Fitzsimmons arriving at the Remizovka site by ski jump chairlift. The city of Almaty in the background. (Photo credit: Charlotte Prud'homme).

After 6 weeks in Kazakhstan, we returned with c. 350 kg of samples and a mountain of memories – of adventures shared and new friends made, and hopefully some great science too.

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THE 2017 ADVANCED CLIMATE DYNAMICS COURSE: AN INTENSIVE TWO WEEKS OF CLIMATE SCIENCE IN NORWAY'S OLDEST NATIONAL PARK

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This year I had the extreme good fortune to be one of 25 students from around the world offered a place on the ninth annual Advanced Climate Dynamics Course (ACDC). The ACDC is a summer school coordinated by the Bjerknes Centre for Climate Research (University of Bergen), in partnership with the University of Washington and Massachusetts Institute of Technology (MIT). The course takes place over two weeks, and is held in a different remote location in Norway or the US each year. This year we gathered in the Rondane National Park in Norway, between the 11-22 September. Accommodation was in the Rondvassbu mountain cabin (Figure 1), on the southern end of the Rondvatnet lake (Figure 2). This provided an excellent base for lunchtime hikes as well as highly invigorating morning dips in the lake for a brave few!

The theme of the ACDC differs from year to year, this year the focus was on understanding the dynamics of the seasonal cycle, based on theory, models, and observations, along with some discussion of how this is preserved in proxy data. This was achieved through a mix of fundamental and advanced lectures, together with student presentations, discussions, and short research projects. This topic was both new and challenging to me; the majority of the other students were climate dynamists, and this resulted in some very in-depth discussions of the physics of atmosphere and ocean circulation on varying time scales. As one of only two 'proxy people' in attendance, some of this went over my head, but I learnt a

Above: Figure 1. Accommodation for the 2-week course was in the Rondvassbu mountain cabin on the southern end of the Rondvatnet lake
Top: Figure 2. Rondvatnet lake, Rondane National Park in Norway.
(Photo credit: all photos Georgia Falster).

Opposite page

Top left: Figure 3. Weekend camping at Bergdalstjønnin.

Top right: Figure 4. Exploring the park on foot.

Middle left: Figure 5. Georgina coring birch on the tree line.

lot about modern climate dynamics, and have come away with many ideas about how I can use this knowledge to better interpret proxy data for past climate change.

Each day of the first week consisted of two fundamental lectures on core topics, followed by summaries of the previous day's lectures given by small groups of students. These summaries were particularly useful, as they sparked discussion around any unanswered questions/topics related to the lectures. The lecturers this year were David Battisti (University of Washington), Jake Gebbie (MIT/WHOI), Peter Huybers (Harvard), Zan Stine (San Francisco State University), Axel Timmermann (IBS, South Korea), and Camille Li, Iselin Medhaug, Kerim Nisancioglu, and Øyvind Paasche (all from the University of Bergen). Some of the topics covered include the seasonal cycle of temperature, the annual cycle in the tropics, annual mean responses and feedbacks to the seasonal cycle, and changes in the seasonal cycle of extremes. The second week consisted of more in-depth lectures, as well as spending time on small group projects. I was part of a group looking into the potential of tree ring density measurements as a proxy for past temperature in Norway, which also involved getting out and about in the national park to take some new tree cores.

Over the weekend we took a boat across the lake, and spent two nights camping at Bergdalstjønnin (Figure 3). The days were spent hiking through the park (Figure 4), learning to recognise and interpret glacial geomorphic features, as well as taking tree cores whenever we found ourselves below the tree line (Figure 5).

We also crammed in as much socialising as possible, in between the pretty hectic academic schedule. This included an International Afternoon Tea, where we all contributed a food item from our home country, as well as a few international movie nights. We also had an outdoor dinner on the second Monday, which started with cooking over an open fire (Figure 6) and degenerated rapidly into disco dancing inside the course tepee. We were also lucky enough to get some highly unseasonal snow, (Figure 7) which of course resulted in the abandonment of group project work for an epic snowball fight.

The ACDC was easily the best short course that I have taken during my candidature – staying in the mountain cabin with an excellent peer group (Figure 8) as well as top scientists who were extremely generous with their time and ideas made for a highly educational fortnight (Figure 9). The course was very well organised, the atmosphere always positive and the scenery just spectacular. Highly recommended for any final-year PhD students/ECRs looking to complement their research – if you're heading along to EGU next year then check out the session 'The Dynamics of Seasonal Cycle and its Signatures Across All Timescales', which is being convened by ACDC attendees, and will feature some of the research performed during the course.

I am grateful to the Soropotmist International (South Australian branch) for partially supporting my travel to Norway.

Opposite page Top: Figure 6. Cooking over an open fire in the field.

Opposite page Bottom: Figure 7. Unseasonal snow.

Below Left: Figure 8. ACDC group participants.

Below: Figure 9. Field lunch with Axel Timmerman.

12TH INTERNATIONAL CONFERENCE ON PALEOCEANOGRAPHY

Utrecht, Netherlands, September, 2016

By Helen Bostock[1], Laurie Menviel[2], Katrin Meissner[2], Taryn Noble[3]

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The 12th ICP was held in Utrecht, Netherlands in September 2016. This is the premier conference for paleoceanography, although in recent years there has been more diversity with presentations on ice cores, speleothems, lake sediments and increasing contributions from the climate modelling community. Thus the name of the conference should probably change to "Paleoclimate" rather than Paleoceanography. The conference is mostly focussed on Quaternary paleoclimate, with some older Cenozoic research as well, especially focussed on time periods such as the Pliocene or the Paleocene and Eocene, which are considered possible analogues for future climate and sea level due to similar CO_2 levels predicted for the next 50-100 years.

The conference has a unique format with only ~30 invited plenary talks of 30 minutes each, and 3 perspective lectures, 1 hour-long, on different specialities of Earth Science, which provide further insight or understanding on climate, oceanographic and ecosystem changes. It is a relatively small conference, with an attendance ranging between 350 and 700 persons. Most of the participants present posters in the well-attended poster sessions, where sometimes heated discussions and/or impromptu mini workshops break out. Several focused workshops are also organised in the days preceding or following the ICP.

It had several main themes covering some of the major research questions in this field. One enduring question in paleoceanography is what drove past atmospheric CO_2 changes and their relationship to paleoclimate. This was covered in the first keynote by Stephen Barker, using a high resolution long marine record from the North Atlantic (ODP site 983) back to 1.2 million years before present (Ma). The new record shows that there was less ice rafted debris prior to the mid-Pleistocene transition (MPT) while interglacials became warmer post MPT. Prior to 1 Ma, the north Atlantic was colder and appears to be obliquity driven. ODP 983 proxy data suggests that Marine Isotope Stage (MIS) 25, at 960 ka, was the first bipolar seesaw termination. The initiation of the bipolar seesaw due to changes in North Atlantic Deep Water formation was suggested as one of the main drivers of the MPT. Post MPT there is evidence of bipolar seesaw during all Pleistocene terminations, with enhanced millennial activity associated with intermediate climate states, including deglaciations. While abrupt climate events are less abrupt in Antarctica, atmospheric CO_2 appears to be better correlated with Antarctic than North Atlantic temperatures, suggesting that the Southern Ocean played a key role in controlling CO_2.

This theme of glacial/interglacial CO_2 changes was continued by Mathias Hain, who used a box modelling approach to model different climate states. He suggested that there were 3 important processes controlling interglacial to glacial CO_2 drawdown: i) increased biological pump efficiency, ii) changes in ocean circulation, and iii) iron fertilisation. There were also many posters studying glacial/interglacial CO_2 changes using a range of different modelling techniques from box models, intermediate complexity models to fully coupled climate models.

There were many talks and posters using the results of the fully coupled global climate models from the Paleoclimate Modelling Intercomparison Project (PMIP3), comparing climate simulations with paleoclimatic data to determine the "skill" of the models (Keynote presented by Julia Hargreaves). The Mid Holocene PMIP 6 ka model simulations have no skill, but this is primarily related to the distribution of the published proxy data, which is mostly on land and clustered in the northern hemisphere. In contrast, the PMIP 21 ka Last Glacial Maximum simulations have reasonable skill for temperature, but are less skilled in simulating precipitation, and regionally there is a stronger correlation in the tropics than in the Southern Ocean.

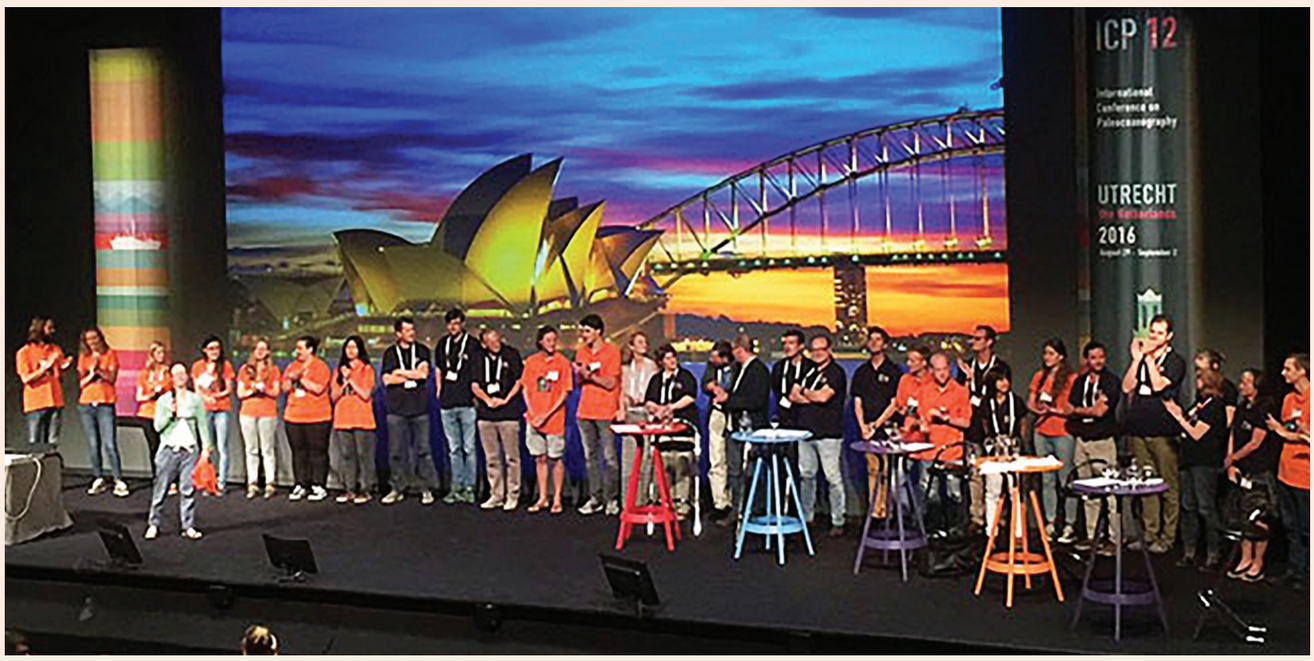
There were also many contributions using models of intermediate complexity. These models include more feedbacks and processes than coupled general circulation models. GCMs, especially on longer timescales, such as feedbacks related to the carbon cycle, sediments,

etc., are numerically less expensive and can be used to test different climate scenarios. These models can also integrate paleo-proxy data directly into the model (e.g. $\delta^{18}O$ in LOVECLIM, keynote by Didier Roche).

While many researchers are still using tried and tested paleo proxies including biotic assemblages and stable isotopes, there are always new paleo-proxies being developed. This year there was a renewed interest in the analyses of the geochemical Na/Ca as a direct proxy for salinity changes in the ocean and continued interest in using other elemental ratios like Mg/Ca for temperature and U/Ca for oxygen or carbonate ion. New developments in B isotopes as a proxy for pH, and Nd isotopes for changes in deep water circulation were presented. Several new organic biomarkers are being developed as proxies for sea ice extent in the Southern Ocean (IPSO25, HBI, keynote by Julianne Muller). There were a lot of posters presenting high resolution elemental data (ITRAX or similar). One of the biggest frustrations in the field of paleoceanography has long been the issues of chronological control and there are regular updates to the radiocarbon calibration curves. Recently U/Th has been used in combination with radiocarbon in speleothems to improve the radiocarbon calibration curves back beyond 20 ka, and linking them to marine sediments for high-resolution millennial scale events (keynote by Larry Edwards).

One of the main themes this year concentrated on how paleoceanography might be able to contribute to our understanding of future climate change. There has been considerable interest in doing high-resolution historical paleoclimate analyses in regions where there are limited historical datasets to help contribute to future Intergovernmental Panel on Climate Change (IPCC) analyses and reports. There has been some success in collecting high sedimentation rate cores from coastal Africa and South America (keynote by Stephan Mulitza). These have focussed on extending historical datasets of ENSO and other climatic phenomena like the Interdecadal Pacific Oscillation where our current records are too short to determine a trend with climate change, and where global climate models are currently unequivocal (keynote by Mahyar Mohtadi). Further south, keynote speaker Amy Leventer discussed using marine sediment cores from around Antarctica to determine whether the recent retreat of sea ice and ice sheet retreat was exceptional. She showed that Larsen A and Larsen B ice shelves had different histories during the Holocene based on cores from underneath the previous locations of these shelves. While Larsen A regularly experienced open ocean conditions between 6.5 and 0.5 ka, a core from under the Larsen B shelf shows that the recent breakup was unprecedented. Larsen C is currently

Figure 1. Handover of next ICP to Sydney in 2019 (Photo credit: Appy Sluijs).



showing a growing rift and potential break up in the future (and has now broken off). This highlights that different ice sheets have different histories. The future theme was also followed up at the end of the conference by a discussion session about the relevance of paleoceanography to the societal climate change challenge.

Beyond the Quaternary, there were several talks about Milankovitch cyclicity and astronomical tuning by physicists Stephen Meyers and Jacques Laskar. Laskar gave a perspective lecture explaining that while the astronomical calculations haven't changed for the last decade they hope to improve them with new data from the Juno mission to Jupiter (which had the least known orbit and distance from the earth). Unfortunately the limit for astronomical tuning is currently 60 Ma, due to 2 asteroids that have chaotic motion and can't be predicted.

Another theme of this year's ICP conference was around the evolution of the main microplankton biota commonly used in paleoceanography with talks about the evolution of phytoplankton coccolithophore and zooplankton foraminifera. There is evidence to show that coccolithophore size and thickness appears to correlate with atmospheric CO_2 concentrations. A compilation of all the foraminiferal isotopes from the Cenozoic shows a decrease in $\delta^{13}C$ and increases in size over time, suggesting that the stable isotopes may have also been affected by evolution, not just climate processes (keynote by Pincelli Hull). The next step is to incorporate biological evolution and ecological systems into climate models. There were a couple of posters attempting to use ecological system modelling approaches with marine fossil assemblage data, showing that this is possible and will be an exciting new way of looking at paleo-datasets.

The ICP also included a busy social program to promote networking. One of the traditional highlights of the International Paleoceanography Conferences is the Paleomusicology Concert. It was originally set up by Prof Sir Nick Shackleton at the very first ICP in 1983. All attendees are invited to participate and the program usually displays a wide variety of skills and music styles (scientists play for scientists...). In Utrecht, this concert took place in a medieval Gothic church, where the attendees could enjoy the various contributions with a glass of wine and excellent food.

The next ICP will be hosted for the first time in the Southern Hemisphere, in Sydney, Australia, at the University of New South Wales, (1-6 September 2019) organised by a committee from Australia and New Zealand (Figure 1). The Facebook page (ICP13 Sydney 2019) and website can be found at http://www.icp13.com.au. We hope to see many paleoclimate scientists from Australasia at the meeting. If you would like to find out more get in touch with Laurie Menviel (l.menviel@unsw.edu.au).

13TH INTERNATIONAL CONFERENCE ON PALEOCEANOGRAPHY
UNDER THE SOUTHERN CROSS
1-6 SEPTEMBER 2019 SYDNEY AUSTRALIA

QUANTITATIVE VEGETATION MODELLING FROM POLLEN DATA DISQOVER WORKSHOP 2017, University of Greifswald, Germany

Haidee Cadd

Sprigg Geobiology Centre, Department of Earth Sciences, The University of Adelaide, SA, 5005, Australia.

On the 4th of September 2017, I began the long journey from Adelaide to the sleepy seaside town of Greifswald in north-east Germany. I was on my way to a workshop that would introduce me to the world of quantitative methods in palynology and easy (supposedly) – to-use implementation in the R-package, DISQOVER.

Quantitative methods in the field of vegetation reconstruction has gained increasing attention over the past decade. Pollen data is the most comprehensive record of past vegetation. However, translating pollen data into past vegetation cover is difficult due to differences in species pollen production biases, dispersal biases and homogeneity biases that can distort vegetation composition estimates.

The application and expansion of these quantitative methods has been hampered in part due to difficulties in running the required models and the requirement for initial vegetation data inputs. The DISQOVER package is open source software that provides a user-friendly, rapid, transparent and open implementation of a variety of vegetation modelling methods. During the workshop, we explored the different quantitative methods, implementing the REVEALS (Regional Estimation of VEgetation Abundance from Large Sites), LOVE (LOcal Vegetation Estimates), EDA (Extended Downscaling Approach) and MARCO POLO (MAnipulation pollen sums to ReCOnstruct POllen of Local Origin) models in the DISQOVER package. We also learnt how to calculate pollen productivity estimates (PPE's) using both surface and core data and discussion of the role of parameter selection, dispersal models and calculations methods on model outcomes (Figure 1).

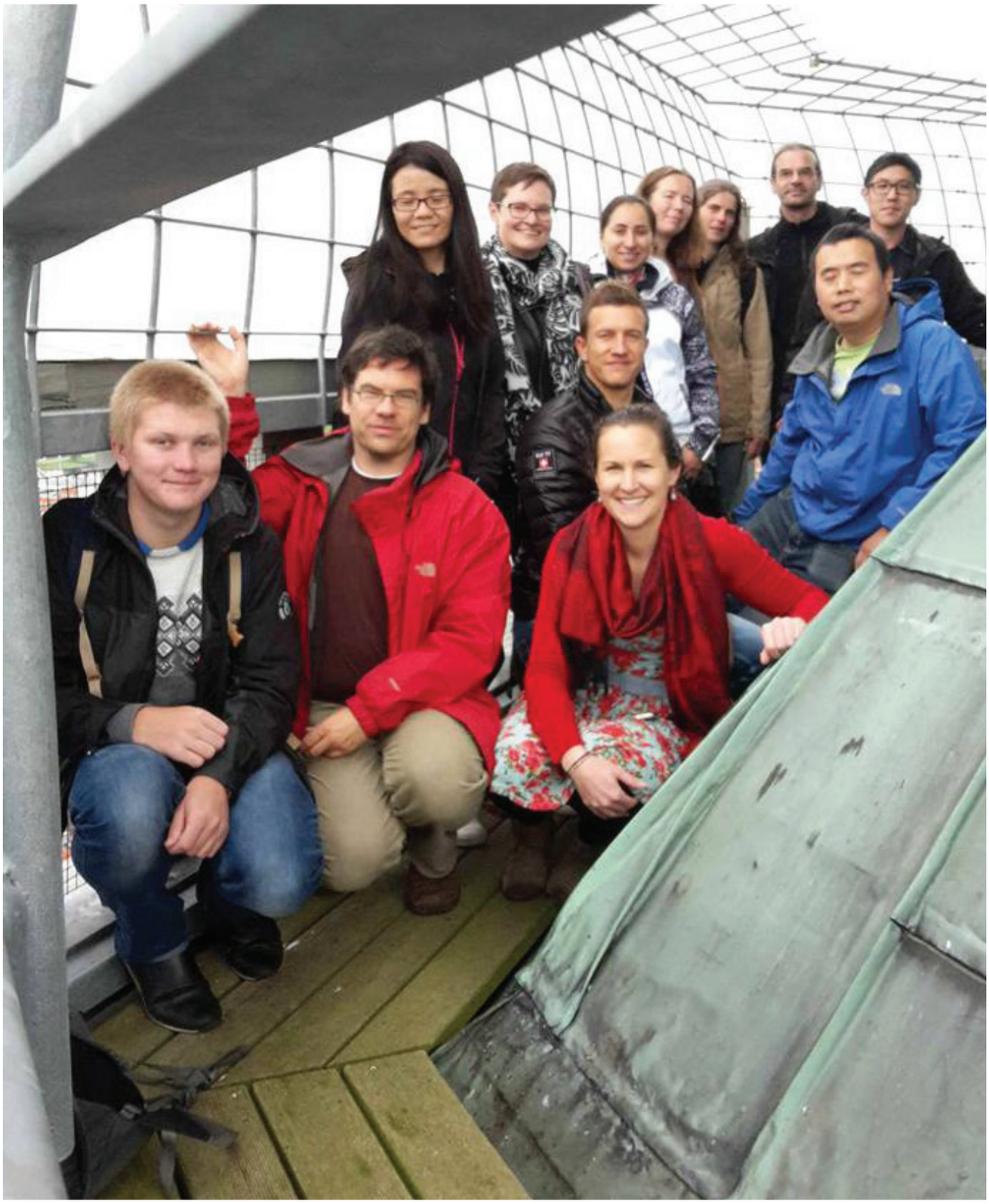
Figure 1. What do you do when it finally stops raining in Germany? Finish your workshop in the sun at the botanic gardens of course (Photo credit: All photos Haidee Cadd).

The requirement of species specific PPE's and pollen dispersal information currently make the implementation of these models in places like Australia and New Zealand difficult, where vegetation surveys and surface sample data would need to be collected prior to model application. The development of a new model, ROPES (Reveals withOut Pollen productivity EStimates), calculates PPE's from core data using pollen accumulation rates (PAR). Whilst still in its infancy this model has great potential for use in places like Australia where PPE information is not currently readily available.

The first DIQSOVER workshop, ran by Martin Theuerkauf, John Couwenberg and Almut Mrotzek was a huge success. The 11 participants from all over the globe brought with them a variety of experiences, helping to develop many great ideas for the future of the DISQOVER package development (eg. Plotting and GIS functions) that will be implemented in the upcoming 0.9 version.

In addition to providing an intellectually stimulating workshop, Martin, John and Almut were amazing tour guides, taking the group on a variety of outings, including dinner on a 20th century trawler, visiting 12th century monastery ruins (Figure 2), climbing the 262 steps of a cathedral spire (Figure 3), exploring a monitoring site of the Greifswald Mire Centre (Figure 4) and enjoying dinner by the Baltic Sea (Figure 5). I left this workshop feeling motivated, enthusiastic and excited about the possible applications of these methods in Australia

Anyone wishing to learn more about these modelling methods can visit the DISQOVER website, http.// disqover.botanik.uni-greifswald.de/ and are welcome to contact me if they would like to hear more about the recent workshop.



Above: Figure 3. The group after climbing the 264 steps to the top of St. Nicholas' Cathedral.

Opposite Page, Top Left: Figure 2. Braving the constant NE German rain to visit the ruins of Eldena Abbey on the outskirts of Greifswald, some of the most famous ruins in Germany.

Bottom: Figure 4. Admiring the mires. Workshop attendee Triin Reitalu with workshop organisers Martin Theuerkauf, Almut Mrotzek and John Couwenberg.

Top Right: Figure 5. Metre beers to end a fantastic workshop.

CAVEPS (CONFERENCE OF VERTEBRATE EVOLUTION, PALAEONTOLOGY AND SYSTEMATICS) 2017, NEW ZEALAND

Sanja Van Huet

Deakin University, Life and Environmental Science and CIE, Burwood, Victoria, Australia.

The 16th CAVEPS (Conference of Vertebrate Evolution, Palaeontology and Systematics) was held from the 3rd to the 5th of October 2017 in Queenstown, New Zealand. The venue was the glorious Skyline on Bobs Peak, accessed either by a 70 minute hike straight up hill or via the (much easier; unless you are elevation challenged) gondola chair lift. There were 53 oral presentations and 15 posters. Oral presentations of interest to Quaternarists were:

Kieren Mitchell, University of Adelaide: 'Towards accurate paleo-demographic histories of Australian vertebrate species; determining how species have responded to past climatic and environmental change'

Gavin Prideaux, Flinders University, Adelaide: 'Body size variation through space and time in island mammals'

Aaron Camens, Flinders University, Adelaide: 'Pleistocene fossil deposits from Cooper Creek, Lake Eyre Basin'

Cassia Piper, Western Australian Museum: 'Palaeoecology and the effects of sea level rise: Decline of mammal species richness during the late Quaternary island formation in the Montebello Islands, north-western Australia'

Jillian Garvey, La Trobe University, Melbourne: 'Zooarcheaology of late Quaternary northwest coastal Tasmania'

Sanja van Huet, Deakin University, Melbourne: 'The Lancefield Swamp Megafauna Locality'

Alan Tennyson, Museum of New Zealand, Te Papa Tongarewa, Wellington: 'What killed New Zealand's birds?

The Riversleigh Prize for long term contribution and achievement was won jointly this year by Ken Aplin (CSIRO) and Trevor Worthy (Flinders University, Adelaide).

The student prizes were won by Hazel Philips, School of Biological Sciences,

Monash University (poster) and Andréas Jannel, School of Biological Sciences

& Vertebrate Palaeontology and Biomechanics Laboratory, University of Queensland (oral).

Several months prior to the conference, a call for 'auctionable' merchandise went out. This was an initiative to secure seed funding for the next conference. Items donated by participants included fossil casts, drink bottles and logo jumpers, limited edition art prints, a variety of signed books and reprints, a poster of a cave system signed and wine from the sponsor.

The auction, which was held at the Conference Dinner, raised $1800.

The next CAVEPS conference will be in 2019.

Delegates at the 2017 CAVEPS Conference, Queenstown, New Zealand. (Photo credit: CAVEPS 2017 Organising Committee)

NEW ZEALAND PALAEO WORKSHOP

Wellington, 28-29 August 2017

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A New Zealand-centric palaeo workshop was held 28-29 August 2017, at Rutherford House, Victoria University of Wellington. The workshop, organised by Drew Lorrey, Marcus Vandergoes and myself, was arranged in support of three linked INQUA-PALCOM activities. The Southern Hemisphere Assessment of PalaeoEnvironments (SHAPE) is an international focus group (IFG) in PALCOM. There are three active INQUA-funded projects housed under SHAPE: Southern Hemisphere Last Glacial Maximum (SHeMax), Southern Westerlies Evolution in Environments of the Past (SWEEP) and Paleolakes of the Arid Southern Hemisphere (PotASH). SHAPE, SHeMax and SWEEP all involve support and leadership from several people from within the New Zealand palaeo community. Furthermore, these activities can benefit from a 'ground-level' stock take and input from New Zealand palaeorecords that have been recently developed and records that are in-progress.

One of the aims of the workshop was to identify spatial and temporal holes in our data network that can be addressed in the near future. With that in mind, the workshop was largely focused on poster presentations of New Zealand records. We also sought to provide an opportunity for established researchers and students to get together to discuss their Quaternary research in an informal setting. In addition to the posters, the workshop included short talks updating the current status of SHAPE (Drew Lorrey), the International Focus Group on Tephrochronology and Volcanism (INTAV: David Lowe), SHeMax (Lynda Petherick) and the Joint Antarctic Research Institute (JARI).

From the workshop, it was agreed that two jointly co-authored papers would be produced, one led by Shaun Eaves, and one by Andrew Rees. One paper will focus on the current state of data coverage for New Zealand, identifying current gaps in our state of knowledge. The other paper will propose protocols/guidelines for our palaeorecords, reviewing the dating methods and proxy techniques.

The workshop was supported by NIWA, GNS and VUW.

A copy of the abstracts is available via this link.

http://aqua.org.au/quaternary-australasia/858-2/new-zealand-palaeo-workshop-abstracts

THESIS ABSTRACTS

Pollen-based quantitative climate reconstructions for Australia, Last Glacial Maximum to present.

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Comparing model output to large-scale quantitative palaeoclimate reconstructions or syntheses is a powerful tool for model improvement as well as for improving our knowledge of the Earth's climate system. Such comparison studies have been largely focused on the northern hemisphere; there have been next to no evaluations of simulated climate changes in Australia because of the lack of continent-wide quantitative palaeoclimate reconstructions available for model evaluation. This thesis is part of an effort to provide such a data set for Australia, first by examining the impact of analytical decisions and sampling assumptions on modern-analogue reconstructions using a continent-wide pollen data set. There is a high degree of correlation between temperature variables in the modern climate of Australia, but there is sufficient orthogonality in the variations of precipitation, summer and winter temperature and plant–available moisture to allow independent reconstructions of these four variables to be made. The quality of reconstructions based on post-1850 CE pollen samples differ little from those using samples from between 1450 and 1849 CE, showing that European post-settlement modification of vegetation has no impact on the fidelity of the reconstructions although it substantially increases the availability of potential analogues. Spatial and/or temporal averaging of pollen assemblages prior to analysis negatively affects the subsequent reconstructions for some variables and increases the associated uncertainties. In addition, the quality of the reconstructions is affected by the degree of spatial smoothing of the original climate data, with the best reconstructions obtained using climate data from a 0.5°C resolution grid, which corresponds to the typical size of the pollen catchment.

When examining the full reconstructions going back 22,000 years, a possible regional bias in the temperature reconstructions is discernible, most likely brought on by a lack of training set samples from the extreme ends of the temperature range. Despite this, several significant, large-scale climatic events were identified, including the cold event associated with glacial re-advance in Tasmania and the Snowy Mountains. The mid-Holocene appears to have been significantly wetter than today in the interior and the end of the glacial period coincided with a sudden increase in bio-available moisture.

The lack of cold climate analogues becomes evident when comparing these reconstructions with PMIP3 model output for Australia for the two key time slices 21 (± 1) ka BP (taken as LGM) and 6 (± 0.5) ka BP. The simulated anomalies for 21 ka BP are slightly closer to previously reconstructed temperatures for this time period than the aforementioned reconstructions are, probably due to the lack of cold climate analogues. The mid-Holocene simulations, on the other hand, were highly variable, both geographically and between models, especially for MTCO. This may indicate that the models have failed to properly take into account all controls on Australian winter climate during the mid-Holocene. While it is unclear what specific controls these might be, it is clear that they are not geographically restricted.

Mind the gap: Geoarchaeology and micromorphology of cave and rockshelter sequences from the Kimberley, north-west Australia

Dorcas Vannieuwenhuyse (PhD)

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Most of the long-term archaeological sequences from north-west Australia are located in cave and rockshelter settings, where deposits are often discontinuous. Yet, there have been few geoarchaeological investigations in such settings in tropical semi-arid regions and in Australia in general. Consequently, the dynamics of site formation processes and their implications for the integrity of the archaeological record are still poorly understood. This thesis aims to rectify this by presenting the geoarchaeological analysis of five Pleistocene and Holocene archaeo-stratigraphic sequences from sheltered sites located in the Devonian ranges of the southern Kimberley region: Riwi, Carpenters Gap 1, Carpenters Gap 3, Djuru and Mount Behn. Located in the adjoining Gooniyandi and Bunuba traditional lands, some of the sites have occupation dated back to the early colonization of Australia about 49–45 ka (cal. BP). The relatively similar cultural, geological and climate setting of the area investigated provides an opportunity to explore and assess the long-term archaeo-stratigraphic record of the region, and, in a larger perspective, people's responses to regional environmental change.

The deposits were examined using micromorphology as the main analytical method, as this technique allows the detailed characterization of sediment components and organization and helps disentangling natural and anthropogenic factors responsible for sediment inputs (or removal). A comprehensive depositional history is presented for each site and shows that they all present unique accumulation/erosion equilibrium. Sedimentary dynamics vary mainly depending on the shelter's position in the landscape, its lithological setting and morphology, the intensity and frequency of human occupation at the site but also local and regional climatic variations.

The micromorphology analysis provides high-resolution insights into human activities within the shelters by characterizing anthropogenic inputs (e.g. botanical or animal parts brought into the sites for consumption or combustion, lithic artefact, rock art painting spalls) as well as assessing their preservation state and stratigraphic integrity by identifying possible post-depositional alterations (e.g. animal bioturbation, chemical processes). A close examination of combustion features allowed identifying a variety of human practices and making the distinction between different types and functions of hearths (flat hearths, ground-oven, rake-out zones) and how they can affect the sequence (physical or thermal alteration).

The micromorphological approach also demonstrates that palaeoenvironmental data can be extracted from cave and rockshelter sequences under tropical semi-arid climate, even when sequences are relatively homogenous in colour and texture, something relatively common under these latitudes. The results reveal that aridification spread from the arid interior to the north over the last 60 ka: the sequence in the most southerly site Riwi shows a shift towards much drier conditions around 45 ka, as indicated by dominant aeolian inputs in the cave from that time. Based on the sedimentary characteristics and associated climatic signals from the Pleistocene sequences of the shelters investigated, the results indicate a progressive but non-linear climate deterioration, with short more humid episodes identified late into the glacial period. Where layers dated to the Last Glacial Maximum (22–18 ka) are preserved, a slower sedimentation rate is observed and is associated with lesser geogenic inputs, probably related to drier conditions at that time and consequent lower landscape erosion processes. Deglacial and early Holocene records (18–8 ka) indicate return to greater precipitation. Mid-late Holocene palaeoenvironmental signals, however, are more difficult to detect because they are overprinted by the generally higher anthropogenic signal present in these levels or records are missing due to erosional processes happening during the Holocene. The palaeoenvironmental changes detected in the five sequences provide a record in direct association with the archaeological datasets, which allows reflection on human-climate interactions. The results show that occupation seems to persevere regardless of glacial climate deterioration, which reinforce the suggestion of the Kimberley region being a refuge during the LGM.

A detailed exploration of the concepts of discontinuities in archaeo-stratigraphic sequences (unconformities, paraconformities, disconformities) and the impact these have on the integrity of the archaeological and palaeoenvironmental record (missing records, time-averaged sequences or palimpsests) is presented and was applied to the five sites investigated. A re-appraisal of other archaeological sites from north-west Australia archaeo-stratigraphic sequences is also presented and stresses the importance of taking into consideration site formation processes biases in Australian long-term human occupation models.

Much remains to be explored to achieve a better comprehension of site formation processes in tropical semi-arid areas, develop a more precise picture of climate changes in north-west Australia and how people responded to them. However, the results of the geoarchaeology investigation presented in the thesis demonstrate the potential of the southern Kimberley archaeo-stratigraphic sequences to inform palaeoenvironmental changes and to comprehend anthropogenic markers better when a microstratigraphic approach is applied.

Two recent fossil sites of the Nepean Peninsula, Victoria: A study of provenance and palaeoenvironmental conditions during the Pleistocene

Chava Sarah Rodriguez (Hons)

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The Bridgewater Formation strata is an extensive record of changing global sea levels during the Pleistocene and the subsequent deposition of varying lithofacies.

On a global scale, Australia hosts the most extensive Pleistocene coastal dune and palaeosol stratigraphy of the Tamala Limestone Formation in Western Australia and the Bridgewater Formation in southeastern South Australia to southwestern Victoria.

The Nepean Peninsula also shares the same strata as the Bridgewater Formation, with both having aeolianites, palaeosols and calcretes beds alternating through the strata. This study aimed to correlate the regional geology of the Peninsula to the Bridgewater Formation using stratigraphic logging, petrographic analysis and Optically Stimulated Luminescence (OSL) dating of the lithofacies at two individual sites – Bay of Islands and Gunnamatta Beach.

The composition of both sites were inferred to be of shallow marine origin with various terrigenous siliclastics, with periods of cementation due to palaeosol formation. Furthermore, the presence of roots and a *Zygomaturus trilobus* fossil skeleton at Bay of Islands and a *Simosthenurus occidentalis* fossil skull just below a taproot horizon were identified at Gunnamatta Beach, signifying a semi-arid terrestrial environment. The Nepean Peninsula has been identified as a southeastern Victorian extension of the Bridgewater Formation of Middle to Late Pleistocene.

As of publication, the OSL dates have not yet been determined but are expected to be younger than 171,000 years based on previous OSL dating of a lower section of the Nepean Peninsula at Diamond Bay.

Jaw disease in an extinct Pleistocene macropod, Macropus giganteus titan Owen, 1838 from Lancefield, Victoria

Anja Thomsen (Hons)

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The Late Pleistocene megafauna fossil site at Lancefield in Victoria contains the remains of *Macropus giganteus titan*, an extinct form of the extant Eastern Grey kangaroo, *Macropus giganteus*.

Horton and Samuel (1978) conducted the only palaeopathology study of the Lancefield *M. g. titan* fossil bones from the Lancefield Classic Site. A 2.4% prevalence of lumpy jaw (mandibular osteomyelitis) was noted, but not all mandibles in the collection were examined at this time. The authors suggested this was a high prevalence, potentially indicative of mass death from waterhole tethering, which can occur in macropods during drought.

This study aimed to determine the total prevalence of lumpy jaw in *M. g. titan* fossil bones from the Lancefield Classic Site assemblage, and complete the 1978 study. The aim was to determine whether the total prevalence could be considered significant, compared with prevalence data from modern macropods and other wild animal populations.

Lumpy jaw prevalence was calculated by examining all *M. g. titan* mandibles from the Lancefield Classic Site, and comparing them with analogies from modern *M. giganteus* from Serendip Wildlife Sanctuary in Victoria, and lumpy jaw data from wild sheep and wild deer populations around the world.

The total Lancefield Classic Site prevalence of lumpy jaw was 1.55 %. This prevalence was lower when compared to lumpy jaw prevalence in the modern Serendip Wildlife Sanctuary *M. giganteus* population (54%). In wild sheep and deer populations a prevalence between 0-8% is considered normal by some authors. However, the significance of the Lancefield Classic Site *M. g. titan* lumpy jaw prevalence remains uncertain, as prevalence data from wild macropods is very limited. Whether the Serendip Wildlife Sanctuary *M. giganteus* population can be considered wild is also questionable due to the highly modified surrounding landscape factors, influences by humans and other possible disturbances that could affect this population.

Further studies on lumpy jaw and potential contributing factors in modern, wild macropods is therefore recommended to establish typical prevalences and potential contributing factors. These studies could improve the understanding of factors that may influence lumpy jaw outbreaks in wild macropods, particularly in the modern context of different ecological settings, landscape modification and destruction, and climate change.

The reliability and validity of bone surface abrasion measurements in vertebrate taphonomy

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The prevailing method for measuring taphonomic abrasion on bone surfaces is the 'Fiorillo scale', an ordinal qualitative scale based on a subjective visual assessment. Despite wide use, the scale has not yet been formally validated.

This study investigates the reliability and validity of the Fiorillo scale. An inter-rater reliability (IRR) experiment tested the degree of rater agreement among and between early stage raters, nonspecialists and specialists, for abrasion on vertebrate fossil surfaces. Overall, Fiorillo scale IRR was fair. Experienced nonspecialist raters were more reliable than either early stage raters or specialists, and specialist reliability was not significantly different from that of early stage raters.

It is suggested that due to the brevity of description in the Fiorillo scale, the method fails to control for specialists' preconceptions developed from prior rating events. High-quality comparative visual examples could be used to control this influence. In addition, the reliability of early stage raters was shown to double during the rating session, while the other groups were unaffected. It is recommended that early stage raters complete a training session prior to collecting abrasion data. Additionally, the validity of abrasion measurement was investigated with a novel quantitative approach.

Three-dimensional meshes of abraded and unabraded bones were generated using a laser surface scanner, and manipulated to identify meaningful changes to mesh shape or volume attributable to sedimentary abrasion. Results from qualitative and quantitative approaches were associated, albeit with a high degree of error caused in part by limited sample size. Results indicate that taphonomic abrasion can be captured without the observer bias inherent in the Fiorillo scale.

This pilot method could be further developed using higher-resolution imagery and experimental reproductions of abrasion features, to convincingly infer palaeoenvironmental conditions from isolated taphonomic data.

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UPCOMING MEETINGS

DECEMBER 2017

Australian Archaeology Association Conference

Venue: Latrobe University, Bundoora

Date: 6-8 December, 2017

http://aaa2017.conferenceonline.com.au/index/1193

2018

FEBRUARY 2018

AMOS ICSHMO 2018 (Australian Meteorological and Oceanic Society and American Meteorological Society Joint Meeting)

Venue: University of NSW Sydney, Australia

Date: 5-9 February, 2018

www.amos-icshmo2018.com.au

APRIL 2018

PALMOD Open Science Convention

Venue: Tech Gate, Vienna

Date: 7-8 April, 2018

https://conferences.geomar.de/conferenceDisplay.pg?confid=11

EGU (European Geosciences Union)

Venue: Vienna

Date: 8-13 April, 2018

www.egu2018.eu

JUNE 2018

POLAR2018 (ASCAR and IASC Conference)

Venue: Switzerland

Date: 15-26 June, 2018

www.polar2018.org

INQUA INTAV (Including TEPHRA HUNT in Transylvania –Crossing New Frontiers)

Venue: Brasov, Romania

Date: 25-29 June, 2018.

www.comp.tmu.ac.jp/tephra/intavtmu/pg772.html

www.facebook.com/groups/INTAV/

ICAR – International Conference on Aeolian Research

Venue: Bordeaux, France

Date: 25-29 June, 2018

JULY 2018

5th International Palaeontological Congress (IPC)

Venue: Pierre and Marie Curie University, Paris, France

Date 9-13 July, 2018

https://ipc5.sciencesconf.orgresource/page/id/38

AUGUST 2018

20th International Sedimentological Congress

Venue: Quebec City, Canada

Date: 13-17 August, 2018

www.isc2018.org

DECEMBER 2018

AQUA Conference

Venue: Canberra

Date: 10-14 December, 2018

ADVANCED NOTICE

JULY 2019

XX INQUA Congress

Venue: Dublin, Ireland

Date: 25-31 July 2019

www.inqua2019.org

SEPTEMBER 2019

13th International Conference on Paleoceanography (ICP13)

Venue: University of New South Wales, Sydney, Australia

Date: 1-6 September, 2019

www.icp13.com.au

DATES TO BE CONFIRMED

2019

SVP Brisbane

2020

Palaeo Down Under 3 Brisbane

TEPHRA HUNT IN TRANSYLVANIA - CROSSING NEW FRONTIERS

Braşov, Romania, 25-29 June 2018

This conference marks the first full tephra of the International Focus Group on Tephrochronology and Volcanism (INTAV) since the seminal meeting in Kirishima, Japan, in 2010. The conference is to be held at Resort Fundata (pictured below), which is near Braşov, Transylvania region, Romania, from 25-29 June, 2018. Easily accessible from Bucharest, and 35 km from the medieval city of Braşov, the venue is located in the mountains just a few kilometres from Bran (Dracula's) castle, with views over the Bucegi and Piatra Craiului Mountains in the Southern Carpathians.

The venue is near several late Quaternary volcanic centres in the east Carpathians (see photo, from Karatson et al. 2017) and the loess fields of the Danube-Black Sea area, where tephras have played an important role in providing chronologies for these sequences.

The conference will extend over a week with a mix of oral and poster papers, workshop sessions, a one day intra-conference field trip (for all participants), and an optional post-conference field trip over 3 days from 30 June to 2 July. A special feature of the meeting will be the commemoration of 50 years of research in tephrochronology since the first paper to utilize the electron probe to analyse major elements in individual glass shards as a 'fingerprinting' tool was published in 1968 (Smith and Westgate 1968, *Earth Plan. Sci. Letters* 5, 313-319).

The following keynote speakers have been confirmed thus far (several more are anticipated):

Prof John Westgate, University of Toronto, Canada: "Application of multiple methods solve a career-long Canadian Quaternary tephra problem"

Prof Christine Lane, University of Cambridge, UK: "Tephra records in east Africa"

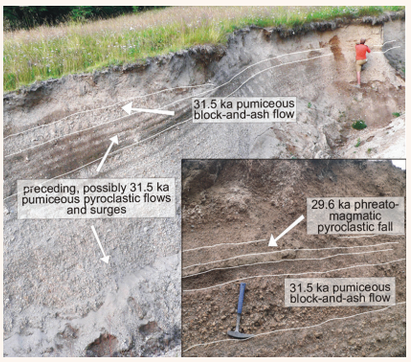
Dr Michael Sigl, Paul Scherrer Institut, Switzerland: "Volcanic forcing, ice-core and tephra"

Prof David Karatson, Eötvös Loránd University, Hungary: "Introduction to regional volcanic history in Romania and adjacent areas"

Dr Sabine Wulf, Portsmouth University, UK: "Land-sea correlations and eastern Mediterranean tephrostratigraphy"

Students and early career researchers are especially welcome, as are those with an interest in loess as well as tephras, and the organising committee, led by Dr Daniel Veres (Romania), is working to ensure that student registrations will be at discounted rates. Possible funding for some travel support for students and ECRs is being sought.

Tephra and cryptotephra studies are enjoying major growth at present. INTAV recently held a highly successful workshop, supported by an INQUA grant, "Best practices in tephra collection, analysis, and reporting: leading toward better tephra databases" on 19 August 2017 in Portland, Oregon, USA. It attracted close to 60 participants including tephrochronologists, volcanologists,



analytical geochemists, and database specialists. Such was the workshop popularity, several potential participants unfortunately had to be turned away because of the limited venue size. The meeting in Transylvania hopes to build on such enthusiasm and so the organising committee and INTAV executive urge you to consider 'crossing new frontiers' and join us at the 'Tephra Hunt in Transylvania' meeting in June, 2018.

Full details regarding registration fees, accommodation and field trips (etc) are due to be announced shortly. The key website is that of INTAV (www.comp.tmu.ac.jp/tephra/intavtmu/pg772.html) and also our Facebook site (www.facebook.com/groups/INTAV/).

For further information, please contact David Lowe (University of Waikato, Hamilton, New Zealand) at david.lowe@waikato.ac.nz.

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Quaternary AUSTRALASIA

Quaternary Australasia publishes news, commentary, notices of upcoming events, travel, conference and research reports, post-graduate thesis abstracts and peer-reviewed research papers of interest to the Australasian Quaternary research community. Cartoons, sardonic memoirs and images of mystery fossils are also welcome.

The Australasian Quaternary Association (AQUA) is an informal group of people interested in the manifold phenomena of the Quaternary Period. It seeks to encourage research by younger workers in particular; to promote scientific communication between Australia, New Zealand and Oceania; and to inform members of current research and publications. It holds biennial meetings and publishes the journal Quaternary Australasia twice a year.

Full annual membership of AQUA with an electronic subscription to QA is AUD50, or AUD35 for students, unemployed or retired people. The AQUA website (www.aqua.org.au) has information about becoming a member; alternatively please contact the Treasurer (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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