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THE STATE OF PALEONTOLOGY IN NEW ZEALAND

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ABSTRACT

New Zealand has a rich fossil record that encapsulates the biological and environmental history of a large and important sector of the southwest Pacific. A century or more of paleontological research has revealed much of this history, but some recent, remarkable discoveries and a plethora of undescribed taxa demonstrate there is clearly a great deal more to learn. The known record has been captured within a unique and essentially complete database, the Fossil Record File. Taken together, these factors point to an exciting future for New Zealand paleontology. To realise this future, however, some major problems must be addressed. Most importantly, the funding emphasis on a narrow range of applied paleontology – principally exploration biostratigraphy and paleoclimate research – must be expanded to allow a reasonable level of basic taxonomic research. Currently and for the past decade or more, applied paleontology has exploited, without replenishment, the finite legacy of taxonomic work undertaken during the latter part of the 20th Century. This is unsustainable; funding managers must realise that applied paleontology is only as strong as its underpinning taxonomy. The problem requires urgent solution because taxonomic expertise – the skills required to teach and mentor a new generation of taxonomists – is disappearing now. More generally, in order to foster a vibrant, innovative, and ultimately useful paleontological programme, funding agencies must support a diversified portfolio of research that makes the most of New Zealand's unique paleontological resources in order to answer questions concerning fundamental geological and biological processes. If these problems can be addressed, then New Zealand will have an exciting paleontological research future.

KEY WORDS: New Zealand; southwest Pacific; Cenozoic; Mesozoic; Paleozoic

INTRODUCTION

New Zealand occupies an isolated position in the southwest Pacific and is the subaerial part (5%) of a largely submerged continent, now commonly referred to as Zealandia (Graham 2009). The onshore fossil record of New Zealand extends back to the Middle Cambrian (506 Ma), although Paleozoic fossils are limited in temporal and geographic distribution (Cooper 2004). Mesozoic fossils, representing all but a few of the international stages, are diverse and distributed widely on the North and South islands. The Cenozoic rock and fossil records are extremely rich and, in terms of outcrop

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area and numbers of specimens, dominant. In addition to the on-shore fossil record, data from off-shore exploration or research drill holes are an important source of paleontological data. In particular, a number of legs of the Integrated Ocean Drilling Program and its antecedent programmes have targeted Cenozoic sedimentary successions beneath New Zealand territorial waters (e.g., legs DSDP legs 29 and 90, ODP leg 181, IODP leg 317).

Paleontological research in New Zealand has a history that extends back to the earliest stages of European settlement in the 19th Century, with the exploits of pioneers such as James Hector, first director of the Colonial Museum and Geological Survey, Walter Mantell, son of Gideon Mantell, and Ferdinand von Hochstetter (see biographies at www.dnzb.govt.nz/dnzb/default.asp). Paleontological expertise has traditionally been concentrated in the New Zealand Geological Survey, now GNS Science, and has been focussed on basic biostratigraphy and taxonomy. To a large extent, this focus was necessitated by New Zealand's geographic isolation and faunal endemism, which mean that biostratigraphic schemes could not simply be imported from Europe or North America but, to a substantial degree, had to be developed from local observations (Cooper 2004). The emphasis was driven by strategic needs of geological mapping and resource assessment, including petroleum exploration. During the early and mid-20th Century, Cenozoic biostratigraphic research benefited from a feedback between government paleontologists and petroleum exploration companies, with the government providing free servicing for exploration wells that, in turn, generated important biostratigraphic data. Key figures during this period were Jack Marwick, Norcott Hornibrook, Harold Finlay, and Sir Charles Fleming, all of whom exerted considerable influence on the development of geological research in New Zealand. For example, Fleming's (1953) meticulous, integrated study of the stratigraphy, paleontology and paleoecology of the Wanganui Basin underpins all subsequent sequence stratigraphic interpretations of this important Plio-Pleistocene section (e.g., Naish et al. 1998).

A paleontologist walks through latest Cretaceous limestone of the Mead Hill Formation in the Mead Stream gorge, Marlborough, in the South Island. This gorge exposes an outstanding section of Late Cretaceous through Eocene limestone and marl and contains a superb record of the K/T boundary and numerous Paleogene climatic events.

CURRENT SITUATION

The Number and Distribution of Paleontologists, and Fields of Expertise

Today, New Zealand, with a total population of just over four million people, has a correspondingly small population of professional paleontologists. The following tallies include only those who are actively engaged in research, exclude students, and count a significant number of paleoecologists focussed on late Quaternary to Recent environmental change. The largest group, 14 research scientists and three active emeritus scientists, is based at GNS Science in Lower Hutt. Another government research institute, Landcare Research, employs two paleobotanists. At the universities, there are paleontological research and teaching staff at the University of Auckland (five people, two of whom are retired), Massey University in Palmerston North (two people, one of whom is retired), Victoria University of Wellington (four people, one of whom is retired), Canterbury University in Christchurch (three people, one retired), the Canterbury Museum in Christchurch (one person), and Otago University in Dunedin (three people). The number of university paleontologists teaching at undergraduate and graduate levels has probably not changed significantly in the past 20 years or so, although the emphasis in teaching has changed dramatically (see below). There are four paleontologists operating within two small, specialist private research companies and consultancies, one in

Auckland and one in Christchurch. In total, therefore, there are 33 professional paleontologists currently employed as such in New Zealand.

Of the 33 professional paleontologists identified above, nine (27%) are macropaleontologists, 11 (33%) are micropaleontologists, and five (15%) are palynologists with expertise in Cenozoic and, in a few cases, Mesozoic and Paleozoic floras and faunas. Of the remainder, seven (21%) are Late Quaternary paleoecologists and one (3%) is a geobiologist.

These figures ignore a few biologists or paleontologists employed in other fields, post-graduate research students, and a handful of amateurs, who publish small volumes of mainly taxonomic paleontological research. In many cases these people work on groups and/or time intervals that are not subject to study by other professional or retired paleontologists.

It is worth highlighting here the important role that amateurs have played in New Zealand paleontology. Given the small number of professionals in the field, the limited financial resources, and the comparatively large territory to be explored, committed amateurs have been able to make extremely important scientific contributions. In many cases these contributions have been greatly enhanced through support given by professional paleontologists. One obvious example is the first discovery and description of dinosaur bones by Joan Wiffen (e.g., Molnar and Wiffen 1994). Another example is the recent discovery of a near-complete, giant penguin skeleton in Oligocene rocks by the Hamilton Junior Naturalist Club; this specimen is now on display in the Waikato Museum, Hamilton.

Funding of Paleontological Research

Although exact figures are hard to come by, it is likely that funding for paleontology in general has remained fairly static over the past 20 years or so, since a major restructuring of science funding starting in the early 1990s. There is no doubt, however, that in real terms, funding levels have dropped substantially from the heyday of paleontology in the mid-20th Century. Currently, paleontological research in New Zealand is funded mainly from three sources. First, studies with an applied emphasis are funded by the government through contestable bids administered by the government science purchasing agency, the Foundation for Research, Science and Technology (but see below). Included here, for example, is paleoclimate research and biostratigraphic research aimed at the hydrocarbons exploration sector. This funding is currently open to scientists in universities, government institutes (e.g., GNS Science), and private individuals or companies.

Secondly, “blue skies” research is supported through the small, prestigious and very highly competitive Marsden Fund (with a proposal rejection rate of between 90% and 95%), which is funded by the government but administered by the Royal Society of New Zealand. Again, this is open to all researchers in New Zealand. Sadly, this is the only source of funding that is available to support paleobiological research that is considered not to have immediate application. As elsewhere (e.g., Smith et al. 2008), cross-disciplinary research – e.g., proposals spanning neontology and paleontology – tends to be disadvantaged in funding applications.

Thirdly, university research is supported through the Performance Based Research Fund, which derives from the government education budget and is administered by the Tertiary Education Commission. This fund does not support specific projects or researchers, but maintains the general research functions of the universities.

The approximate stability in funding that is inferred belies a major change in the New Zealand paleontology that has occurred over the past two decades, in both universities and government institutes, namely a change in research emphasis. This issue is explored below.

It is worth noting here that the government-owned institutes, such as GNS Science, operate within a full cost-recovery business model. GNS now derives about half its income from contestable government research funding, noted above, and the remainder from consultancy for the private sector, other government agencies, and local government authorities. In general, growth of the research institutes over the past decade has been generated largely by increasing commercial revenue, and exploration-related research has been an important, though approximately steady, revenue stream for paleontologists at GNS Science.

Paleontological Collections

The National Paleontological Collection is housed at GNS Science in Lower Hutt. This is by far the largest collection in the country, with over 84,000 sample lots, each comprising between one and several thousand individual fossils and, in many cases, unprocessed bulk sample. Of these sample lots, 17,000 are macrofaunal or macrofloral; the remainder are microfossil. Since 2006, the National Paleontological Collection has received

stable "backbone" funding to upgrade facilities to the appropriate standards and ensure long-term security and development of the collection. This fund also supports limited, related research and outreach activities. The collection is maintained by two full-time technical curators and by specialist scientific staff at GNS Science.

Six other significant fossil research collections are housed at the University of Auckland, Auckland Museum, Te Papa Tongarewa Museum of New Zealand in Wellington, Canterbury University, Canterbury Museum, and Otago University. Standards of curation vary; some collections have dedicated paleontological curators, whereas others rely on the energies of teaching or research staff and/or are managed under the wider umbrella of marine invertebrate collections. The museum collections are funded mainly through grants from local authorities, although small competitive grants are available from central government. University collections are sustained from general university operational funds (see above). In general, although there are no perceived threats to any of these collections, their long-term development may be contingent, to some extent, on the presence of energetic paleontological champions.

The Fossil Record File

New Zealand paleontologists have a national resource that is, to the best of our knowledge, unique in the world. This is the Fossil Record File (FRF or FRED), a national database of fossil localities that was initiated in paper form in 1946 and now has been fully digitised (see www.fred.org.nz/index.jsp). The FRF was established by the then New Zealand Geological Survey, but is now run jointly by the Geoscience Society of New Zealand (see below) and GNS Science. It records geographical location, geological context, and collection details of fossils, and preserves varied identifications and interpretations obtained over the years. Importantly, it has been populated by government and non-government, and professional, academic, student, and amateur paleontologists. The FRF is essentially, therefore, a more-or-less "complete" database of known fossil localities in New Zealand. Currently, the FRF contains information on almost 95,000 fossil localities.

The FRF is classified as a "database of national significance". Following a period of inconsistent funding for such databases, recent years have seen a significant change of policy and now the FRF has dedicated "backbone" funding. Since 2006, this funding has allowed a concerted effort to complete entry of a substantial backlog of data and to begin the important task of upgrading functionality of the database.

Journals

There is no specialist paleontological journal published in New Zealand. Instead, much specimen-based paleontology has traditionally been published in three local journals:

1. *The New Zealand journal of geology and geophysics*, published quarterly under this name since 1958, currently published by the Royal Society of New Zealand; 2008 ISI impact factor 0.62, five-year impact factor 0.71.
2. *The Journal of the Royal Society of New Zealand*, published quarterly under this name since 1971 by the Royal Society of New Zealand (with antecedents dating back to 1868); 2008 ISI impact factor 1.04, five-year impact factor 0.92. Following some uncertainty regarding the future of this and the previous journal, the Royal Society of New Zealand has very recently adopted new publication procedures and entered into a partnership with a large publishing house, Taylor and Francis. These changes should enhance the dissemination and impact of both journals.
3. *GNS monograph*, published occasionally by GNS Science since 1993; this series subsumed the former series *New Zealand Geological Survey paleontological bulletin*; impact factor not available. This series allows for the publication of large monographic works that are relevant to New Zealand geology and paleontology.

In addition to these New Zealand-based journals, there are two journals that are published in Australia by the Australasian Association of Palaeontologists, a specialist group of the Geological Society of Australia. These journals, *Alcheringa* and *Memoirs of the Australasian Association of Palaeontologists*, have not been used extensively by New Zealand paleontologists, but represent important potential outlets for articles relating to paleontology in the southwest Pacific region. *Alcheringa*, published quarterly, has 2008 and five-year ISI impact factors of 0.51; statistics are not available for *Memoirs*.

Geoscience Society of New Zealand

New Zealand has no dedicated paleontological society but, instead, paleontologists have formed an active special interest group within the

Geoscience Society of New Zealand (created in 2010 by amalgamation of the former Geological Society of New Zealand and New Zealand Geophysical Society), see: http://www.gsnz.org.nz/index.php. This society organises an annual conference that attracts around 200-300 participants, spans 3-5 days, and has field trips and talks covering all fields of geology. In addition, it has branches throughout the country that host monthly talks and occasional field trips.

THE FUTURE: OPPORTUNITIES AND PROBLEMS

Future Funding of Paleontology and Paleontologists

At the time of writing, science funding in New Zealand is undergoing significant restructuring, with amalgamation of government agencies responsible for science policy and purchasing, and clarification of the core purpose of government science institutes such as GNS Science. The likely impacts of these changes on funding of paleontological research may not be manifest for some time although, taken at face value, they do not seem to threaten support for core, *applied* paleontological research. Such funding is, of course, always vulnerable to sometimes rapidly changing priorities of government and funding agencies. At present there is little more that can be said on this subject.

Similarly, university research funding administered through the Performance Based Research Fund is also likely to be restructured to some extent in coming years. Again, the likely impacts of this restructuring are not yet clear, but it is possible that changes will enhance the ability of universities to employ young, early career staff.

Underpinning paleontological research in both government institutes and universities will continue to receive, at best, only extremely limited funding through the Marsden Fund. For this reason, much of what would fall under the umbrella of modern paleobiology – study of taxic rates, functional morphology, evolutionary and evolutionary-developmental biology, macroevolution, macroecology, integrated molecular-paleontological studies, etc. – remains largely and regrettably absent from New Zealand research agendas.

Strengths and Opportunities

The comparatively short history of paleontological exploration in New Zealand, the small number of paleontologists, and the presence of significant tracts of geologically under-explored terrane, mean that there is still much to learn about the fossil history of the country. By way of illustration, we note the very recent, first description of dinosaur footprints in the country (Browne 2009) and the remarkable discovery of a Miocene, non-volant, terrestrial, mouse-like mammal (Worthy et al. 2006). Furthermore, given New Zealand's long-standing geographic isolation and floral and faunal endemism, the fossil record furnishes the means to test globally significant biogeographic hypotheses. For example, a recent study raised the possibility that New Zealand was entirely submerged during the Early Miocene (Landis et al. 2008). If correct, then this has important implications regarding the relative importance of transoceanic dispersal *versus* vicariance, and the role of refugia, in the development of New Zealand's distinctive biota. The questions raised will only be answered through the integration of geological, paleontological, biological, and molecular data. Other opportunities lie in the rich fossil records of specific groups, such as Cenozoic marine mammals, which have been the subject of a sustained research programme at the University of Otago (e.g., Fordyce 2006). A highly rewarding arena of research could be built around the Fossil Record File (FRF). In particular, this resource offers the possibility to study diversity dynamics and macroecological controls on those dynamics in biogeographically "captive" faunas. Although such studies have been undertaken to a limited extent, using molluscs as a model group (e.g., Crampton et al. 2006), the full potential of the FRF has yet to be realised in this regard.

One area in which New Zealand will continue to make important contributions to the global scientific effort is in paleoclimate research. New Zealand has much to contribute in this field because of its isolation in the southwest Pacific and its position in the westerly wind belt, astride a major oceanic boundary and adjacent to the largest deepwater inflow on the planet. Substantial volumes of integrated paleoclimate proxy data from both onshore sections and offshore research drillcores are becoming available, including quantitative analyses of various microfossil groups, trace element and stable isotope analyses, and organic geochemical analyses. New Zealand paleontologists have also been heavily involved in the analysis of stratigraphic cores taken from the Antarctic margin over the past two decades (notably Cape Roberts and Andrill cores). In the field of paleoclimate research there is a strong tradition of collaboration with overseas researchers, including (paleo)climate modellers (e.g., Hollis et al. 2009). One

important recent development is New Zealand's joining of the Integrated Ocean Drilling Program in partnership with Australia (see: drill.gns.cri.nz/nzodp/index.html). This will enhance access for New Zealand scientists to both drilling legs and the decision making process within the programme, and will open up new opportunities for paleoclimate and paleoceanographic research in New Zealand.

Weaknesses, Threats and Opportunities

As noted above, the past 20 years has seen a very significant change in emphasis in paleontological research in New Zealand, and this has implications for the future of the subject. During much of the 20th Century, the emphasis in both paleontological teaching and research was on systematics, taxonomy and biostratigraphy across the geological time scale – subjects that matched the strategic needs of basic geological mapping and frontier-type resource exploration. Changing government priorities in the early 1990s saw greater emphasis on science that was deemed to have more immediate relevance to society. This resulted in a shift towards applied Cenozoic biostratigraphy, micropaleontology and paleoenvironmental research, and a very substantial loss of expertise in taxonomy in general and Paleozoic-Mesozoic macropaleontology in particular. Hence, there are now just one or two researchers working part-time on Mesozoic macrofossils and only one person studying Paleozoic fossils. The loss of expertise in Mesozoic and Paleozoic macropaleontology may be recovered relatively quickly (i.e., within 5-10 years) given the appropriate stimuli. Indeed, this might be viewed as an opportunity for a new generation of paleontologists (bearing in mind funding constraints).

In contrast, the loss of taxonomic expertise is more profound and has severe implications for the future of the subject. Amongst those employed as paleontologists in New Zealand today, there is only a small handful that routinely publishes alpha taxonomy. This problem is global, is common also to biology, and has been discussed at length elsewhere (e.g., Adrain and Westrop 2003, and, for local, neontological perspectives, Black 2008, Bradford-Grieve 2008). As noted by others, any biostratigraphic, biodiversity, evolutionary, or paleoecological research – applied or otherwise – is only as good as the underpinning taxonomy. There is no doubt that much of the applied biostratigraphic and paleoenvironmental research of the past decade or two has been "mining" the finite legacy of taxonomic work undertaken during the latter part of the 20th Century. It is clear that a very large number of fossil species await formal description (e.g., Spencer et al. 2009): in Cenozoic Mollusca alone, approximately 2,000 of 5,000 known species are undescribed. Of greater concern to us, however, is not the slow rate of taxonomic description or loss of taxonomic expertise *per se*, but the loss of experienced practitioners who have the necessary skills to even *teach* the discipline. Whereas the present changes to science funding in New Zealand *may* furnish the means to address this problem, any such changes will need to be matched by a change in the perceptions of science managers and policy agencies regarding the relevance of alpha taxonomy. In part, this is an issue of communication, which is discussed below. As things stand, the loss of taxonomic expertise is a severe threat to the long-term health of paleontology in New Zealand.

One particular problem facing New Zealand scientists is geographic isolation and the great cost of travel to/from the country. Over the past decade or so, research visits to/from New Zealand have increased because of the falling cost of air travel and the recognition by science managers of the importance of international collaboration. Furthermore, small amounts of government funding have been set aside to enhance opportunities for collaboration between New Zealand and overseas researchers, such as the International Science and Technology Linkages Fund administered by the Royal Society of New Zealand. Some high-profile and successful conferences have been held here, such as the 2009 "Climatic and Biotic Events of the Paleogene" (http://www.gns.cri.nz/cbep2009/), and productive international collaborations have helped to take New Zealand paleontological research in new and exciting directions. Despite these positive developments, compared to their European and North American colleagues, most New Zealand paleontologists have relatively few opportunities to participate in international meetings or visit overseas institutions. Even with rapidly increasing levels of electronic communication, this problem will certainly remain a significant impediment to the development and maintenance of international collaborations.

The Importance of Outreach Communication

There is a growing awareness amongst many scientists of the need to communicate the relevance of science to society in general. Increasingly, the public are expected to engage in scientific debates on topics such as climate

change, genetic modification, immunisation, the risk of pandemics, and evolution. It is incumbent on scientists, and very much to their benefit, to communicate their science in an effective and interesting way to all sectors of society and all age groups. In the present context, paleontologists must take every opportunity to explain the importance of research into fossil taxonomy, evolution, extinction, and the development of regional biotas. As paleontologists, we start with a natural advantage in this regard, given the widespread appeal of fossils in the general populace. In this respect, it is worth noting the great success of a recent exhibition, "New Zealand fossils: dead precious!", that was sponsored by GNS Science and Shell New Zealand Ltd., toured nine museum venues nationally between 2008 and 2010, and was viewed by 524,000 people or 12% of the population. This exhibition aimed to display fossils as objects of fascination, but also to explain their relevance to understanding of evolution, extinction, geological hazards, and resource exploration. A second example of successful outreach communication is the "Vanished World Centre and Trail" in north Otago, in the South Island (see: http://www.vanishedworld.co.nz/index.htm). This endeavour, an inspiring initiative between the University of Otago and local landowners, includes 19 sites at which fossil invertebrates and whales and interesting land-forms can be viewed, and a small museum that is managed by the landowners themselves. Finally, we note the recent publication of a book that provides details of accessible, safe and sustainable fossil localities, and encourages public viewing and/or collecting (with appropriate caveats!) at those sites (Crampton and Terezow 2010). The book fills an information gap and aims to foster public interest in, and understanding of, the diverse scientific narratives that emerge from modern paleontology.

SUMMARY AND CONCLUSIONS

Looking forward, paleontology in New Zealand has, perhaps, an exciting future that can build on several strengths. New Zealand's fossil record is superb, particularly for the Cenozoic Era. This record (including offshore drill core data) is the only source of information on the biotic history of a large segment of the southwest Pacific and, for this reason alone, has global significance. This significance is amplified by New Zealand's oceanographic and climatic setting, its biogeographic isolation, and the endemism of its biota. These factors mean that the fossil flora and fauna can provide important data for testing and formulating paleobiological, paleoclimatic and paleoceanographic hypotheses. New Zealand's paleontological infrastructure, in particular the Fossil Record File, hugely enhances opportunities for research.

The discipline must, however, face up to a number of serious challenges, some of which are common to the subject world-wide. New Zealand's known fossil fauna and flora are far from fully described, and undoubtedly much remains to be discovered. In part, this simply reflects the small number of paleontologists and the comparatively large size of the known and potential fossil record. Whereas this might be viewed as an opportunity, in fact the emphasis in research funding now dictates that almost no taxonomic research is being undertaken and, therefore, the undescribed and unknown parts of the fossil record are likely to remain thus. There is no evidence to suggest that this situation will change: underpinning research into taxonomy and many areas of biostratigraphy and paleoecology seems to have little future in the New Zealand funding regime. Instead, there is a focus on geological research in the fields of energy exploration, climate change and hazards, and the future of these areas of applied paleontology seems to be reasonably assured. It would appear also that funding for paleontological databases will be maintained, for the time being at least. The lack of basic taxonomic study is a major threat to the viability of *all* areas of derivative, applied research: we can simply restate that applied paleontology is only as strong as its underpinning taxonomy. If applied research is based just on the known biota then, up to a point, it can only deliver refinements of the already known. This problem requires immediate attention because taxonomic expertise – the skills required to teach and mentor a new generation of taxonomists – is disappearing now. Looking beyond taxonomy and so-called applied research, opportunities to use the New Zealand's unique paleontological resources to advance our understanding of fundamental geological and biological processes, to enhance the country's scientific standing, and to advance international collaborations, are very limited.

The way forward is not clear. To foster a vibrant, innovative, and ultimately useful paleontological programme requires a diversified portfolio of research. New Zealand paleontologists – and, indeed, the global community – must take every opportunity to reinforce this message to those setting funding priorities, to policy makers, and to soci-

ety in general. And, to the extent possible, we must take responsibility for prioritising our own science. A first step is to vigorously promote basic paleontological research that can be linked to other areas with perceived, medium-term societal or economic returns. Fortunately, as paleontologists, our subject material – the evolution and (mass)extinction of strange animals in strange environments and the development of the biosphere as we know it – has wide appeal and finds an eager audience. We must engage this audience and we must be proactive and forceful.

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PE NOTE:

For more on the paleontology of New Zealand in *Palaeontologia Electronica,* see the following papers:

1. PE10.1.3A Lauraceae Macrofossils and Dispersed Cuticle from the Miocene of Southern New Zealand (2007)
   palaeo-electronica.org/2007_1/zealand/index.html
2. PE10.1.4A Microfacies of Stromatoliticicrofacies of Stromatolitic Sinter from Acid-Sulphate-Chloride Springs at Parariki Stream, Rotokawa Geothermal Field, New Zealand (2007)
   palaeo-electronica.org/2007_1/sinter/index.html
3. PE10.3.14A Monocot Macrofossils from the Miocene of Southern New Zealand (2007)
   palaeo-electronica.org/2007_3/125/index.html
4. PE11.3.15A Dispersed Leaf Cuticle from the Early Miocene of Southern New Zealand (2008)
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5. PE13.2.14A Ecology of Paleocene-Eocene Vegetation at Kakahu, South Canterbury, New Zealand (2010)
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