ISSN 0028-8667

New Zealand Science Review

Vol 64 (3–4) 2008

Official Journal of the New Zealand Association of Scientists
P O Box 1874, Wellington
www.nzas.rsnz.org

A forum for the exchange of views on science and science policy.

Editor: Allen Petrey
Production Editor: Geoff Gregory

Contents

Cover photo: Female *Viciria praemandibularis,* a jumping spider from Singapore, body length 12 mm.

Instructions to Authors

New Zealand Science Review provides a forum for the discussion of science policy. It covers science and technology in their broadest sense and their impacts on society and the environment, both favourable and adverse. It also covers science education, science planning, and freedom of information. It is aimed at all scientists and decision makers, and the interested public. Readability and absence of jargon are essential.

Manuscripts on the above topics are welcome, two copies of which should be sent to:

The Editor
NZ Association of Scientists
P O Box 1874
Wellington

As well as full papers, short contributions, reports on new developments and conferences, and reviews of books, all in the general areas of interest of the journal, are invited. The journal also accepts reviews of a general nature and research reports.

Full manuscripts (with author's name removed) will be evaluated and authors will be sent copies of the reviewer's comments and a decision on publication. Manuscripts should not normally have appeared in print elsewhere but already published results discussed in the different, special context of the journal will be considered. They should preferably not exceed 2500 words.

To facilitate anonymous review, author's names on manuscripts and any acknowledgement of assistance should be on a detachable cover page. Manuscripts should be accompanied by biographies of not more than 100 words on each author's personal history and current interests. Authors are also expected to supply a suitable passport-size photograph of themselves.

Manuscripts should be typed double-spaced with wide margins on one side of the page. Articles may be submitted in Word for PC, rich text format, or plain text, by e-mail, or on floppy disk or CD-R, but a hardcopy should also be sent so that fidelity may be confirmed. Diagrams and photographs should be on separate files (preferably eps, tif, jpg, all at 300 dpi), not embedded in the text.

All tables and illustrations should be numbered separately – Tables 1, 2, 3, 4, etc., and Figures 1, 2, 3, 4, etc. – and be referred to in the text. Footnotes should be eliminated as far as possible. Diagrams and photographs will be printed in black and white, so symbols should be readily distinguishable without colour, and hatching should be used rather than block shading.

References should preferably be cited by the author–date (Harvard) system as described in the Lincoln University Press *Write Edit Print: Style Manual for Aotearoa New Zealand* (1997), which is also used as the standard for other editorial conventions. This system entails citing each author's surname and the year of publication in the text and an alphabetical listing of all author's cited at the end. Alternative systems may be acceptable provided that they are used accurately and consistently.

Editorial

Are scientists and technologists contributing effectively to political decision-making around the big issues?

There are several big challenges to the quality of human existence on planet Earth: over-population, resource limitation (fossil fuels, water, mineral and biological resources, etc.) and climate change. Each of these challenges stands alone in the solutions they require, but the problems and solutions interact, sometimes in ways that are negative. For example, growing populations are putting increasing pressure on resources and natural ecosystems, attempts to produce non-fossil organic fuels are leading to food shortages, and climate change may lead to lowered food production in some regions, with consequent starvation, social unrest, and breakdown of international order. In spite of these problems becoming increasingly evident, the public debate, global governmental actions, and media reporting relating to these three issues are confused in that they often consider issues in isolation.

Biofuels have been proffered as an appropriate response to climate change. Nevertheless, several studies (e.g. http://web.mit.edu/newsoffice/2007/ethanol.html) show that many methods of producing biofuels produce little more energy than the non-renewable energy it took to produce them. Biofuel producers, shielded by subsidies from the economic realities of their activities, are increasing demand on food crops. This is resulting in disastrous increases in food prices for our over-populated world.

The question that arises is whether we collectively have the data, understanding, and the will to act effectively in response to the problems of over-population, climate change, and resource limitation? Can we work towards a more integrated approach at a national and international policy level? Do we have technological solutions to the carbon emission problem? What priority should we place on human life in the short and long term? Are we asking the right questions?

It is entirely possible there will not be enough timely, technological fixes to mitigate climate change and related perturbations , to constrain over-population and to adapt to resource limitation. Some current policy directions in regard to reduced carbon emissions, while attempting to maintain business as usual, are not sensible.

Scientists and technologists could make an important contribution by identifying the most important questions and focusing the debate on them. At the moment, we have no generally-accepted, unified way of appreciating our total energy use and its sources (renewable and non-renewable). All the goods and services that we use and consume have an energy component. Yet it is very difficult for decision-makers and ordinary people to know the amounts and types of energy that each contains. Some of the techniques that we may need to make such assessments are already in existence although they probably need adaptation and development.

The late Howard T. Odum, a well-known ecologist, developed the concept of 'emergy' to quantify the energy used in creating a product or transforming raw materials into processed materials (*Environmental Accounting* ,Wiley, 1966). The word has connotations of embodied energy and remembered energy and the concept has been used in accounting for environmental and economic use of energy. Because the amount of emergy in a product depends on the energy source used, it is common practice to convert to solar emergy, the equivalent amount of solar radiant energy used. Although the concept of 'emergy' needs more rigorous development these ideas should have application in appreciating the size of the problem we have in reducing carbon emissions and in understanding the relationship between energy use and standard of living. His book gives food for thought in his analysis of emergy/US$ ratios in different countries. In this context he specifically mentions New Zealand (p. 213) in showing that, in the production of aluminium, most of the benefits go to the importing countries (this analysis does not take into account the foreign ownership of the smelter at Bluff or the exported dividends). The export of energy in the form of aluminium is quite unhelpful to New Zealand's decision to become more 'carbon neutral'.

The creation of an inventory of the emergy content of all goods and services, produced in New Zealand or imported, would give us the data to evaluate our chances of success in reducing carbon emissions without outright reduction in energy consumption and standards of living. This type of analysis would ensure that we focus on the most effective actions. We would have the data to focus on the areas that would have the greatest impact, first choosing actions that would stand us in good stead, even if the resulting climate change turned out to be not as bad as predicted .

If the analysis shows that we have no chance of reducing emissions in time to head off dangerous climate change while retaining our standard of living, then it would be better to know this at the outset and to focus on adaptation and how we might adjust to resource limitation and international unrest in a globally responsible way. The concept of embodied energy is not exactly unknown in New Zealand as the School of Architecture, Centre for Building Performance Research is studying the energy costs of houses (http://www.victoria.ac.nz/cbpr/projects/embodied-energy.aspx).

Strong leadership is needed to address these issues but may be thwarted by institutional arrangements in the New Zealand Research, Science and Technology system. The Royal Society of New Zealand through its National Science Panel has taken an initiative in its recently released 'Science Manifesto', in calling for the establishment of an office of Chief Scientist. NZAS challenges New Zealand scientists and technologists to support this lead as a means to more effectively contributing to our political decision-making process.

Janet Bradford-Grieve, James Renwick, and Dennis Gordon
for NZAS Council

President's Column

It feels distinctly strange sitting down to write my first President's column for the NZAS. Perhaps not as strange as finding myself President just two years after Neil Curtis stopped me in the corridor on his way to the AGM of NZAS and 'asked' me if I would be on its Council. With all the due diligence of two seconds, I shrugged my shoulders and said, 'Sure, OK', as is my norm, despite having never heard of the NZAS before. In fact I find that many of my colleagues have never heard of the NZAS, let alone considered becoming members of the organisation. With its prime driver being to work for, and in, the collective interests of science in New Zealand, in all of its guises, why do so few people know about the Association and even fewer become members? Given the central status (at least in my opinion) that science should have in New Zealand's economic future, such an organisation is critical. Or are we all just complacent and too locked into our own existence to want to see science moving forward? Would we rather just have the smugness that we are justified in complaining about the place of science and the level of funding, although we never actually stand up and work towards changing it?

Each of us will have our own view on what should, could, and can be changed in our current system, to a greater or lesser extent, and who is responsible ultimately for getting it changed. So the question is, why aren't you doing something about it? And if you don't want to do it personally, where can you go to get someone else to pick it up for you?

It must be noted that others, who have been playing this game longer than I have, have said, seriously, that although the playing field has changed, it is not clear that it is worse. However, from where I am sitting, with the pressure I feel all the time and the growing list of what is expected of me now as a scientist – to be a fantastic public educator, a world-leading (not just world-class) researcher, an effective administrator, and an entrepreneur turning out start-up companies – I beg to differ.

Two circumstances have recently highlighted how frustrated, annoyed, and saddened I am about the place of science in New Zealand and those directing it (and I don't mean the scientists here), and the very long road ahead that must be travelled for science to be put on firmer ground and for scientists to be credited with true worth.

The first of these was the release by the Ministry of Research, Science & Technology (MoRST) in October of the Agenda Document for comment by the middle of January – a time when all the societies are dormant, people are on holiday or finally hoping to get some concentrated research time and involved in writing bids. My history as a practising scientist in New Zealand only dates back ten years, but the scuttle-butt indicates that this document is just one in a stream of similar ones that seem to me to miss the point, reinforcing the limited conceptual understanding by policy makers of being a practising scientist now in New Zealand. One thing I found particularly galling is the concept that support should go to the best people and teams, and that there is to be a consolidation of research, but there is no mention of how the pretty damn good ones are going to be supported or how we will endeavour to maintain any real breadth or individual/small-group research thrusts or deal with potential disinvestment. There are many other things in the document that I could highlight but, if previous documents are anything to go by, will anything actually come of raising it? When one takes this document in conjunction with MoRST's Roadmaps for Science, it tends to leave you wondering how the divide between practising scientists and those dictating to the scientists got so big?

Secondly, like many others around the country I have spent a considerable portion of my time since returning to work three weeks ago writing grant applications; the Marsden Fund and the New Economy Research Fund (NERF), both due conveniently at the same time – thanks for that, MoRST/RSNZ and FRST! Of course, some would say that at least I was in the second round for NERF, and they are right – we all know that at least if you get to the second round your chances are enhanced enormously. But still, for a physical scientist, the realisation of the vacuum that exists between the highest pinnacle that can be achieved in the Marsden, where it is all the science and the scientists, and the base funding for a short-programme NERF, where it seems to be substantially weighted towards business and money, makes you wonder what it is you have to do to be a successful scientist in this country.

So is it fair and reasonable to surmise, based on the above, that only if you equate to the top handful of scientists in New Zealand will you be deemed worthy? Certainly from where I stand that status isn't even a nanodot on the horizon. So what do we do? How can we individually and collectively be heard? How do we ensure that we are not in a system of complacency, nor one of total competition, nor one that supports only those of us who are in either the international elite or promising new companies turning over millions within five years?

In my opinion these, and more, represent the challenges to be met for all practising scientists in order to ensure a solid future for New Zealand – one that is to a large extent founded on science excellence and far-sighted planning. An organisation like the NZAS should be at the forefront of that effort.

This is where we start 2008. The test is to ensure it is not also where we leave it. So the thrust for the NZAS in 2008 will be to increase its visibility, to attract a higher level of support from our scientific community, to be more vocal on issues of importance (using outside experts when necessary), and to begin to address with the Government the true and central importance of science to New Zealand's future. I hope you will actively join in and support this campaign, by at a minimum talking to your colleagues about the Association and encouraging them to join us and get involved.

Kate McGrath
President NZAS
January 2008

Article

New Zealand's UNCLOS Project—defining the continental margin: a summary and way forward

Ray Wood and Bryan Davy
Institute of Geological and Nuclear Sciences Limited, PO Box 30-368, Lower Hutt

Introduction

Scientists, administrators, lawyers and diplomats have spent the last ten years determining the extent of New Zealand's legal continental shelf as defined by the United Nations Convention on the Law of the Sea (UNCLOS; Figure 1, also referred to in the text as 'The Convention'). This was a massive, $44 million project that involved a multi-disciplinary and multi-institutional team who collected and analysed a vast amount of data from the outer parts of New Zealand's offshore region.

New Zealand ratified UNCLOS on 19 July 1996, and lodged a submission defining the outer limits of its continental shelf with the United Nations Commission on the Limits of the Continental Shelf (CLCS) on 19 April 2006. UNCLOS is a wide-ranging agreement that provides a framework for managing the oceans, including economic, environmental, and sovereignty issues.

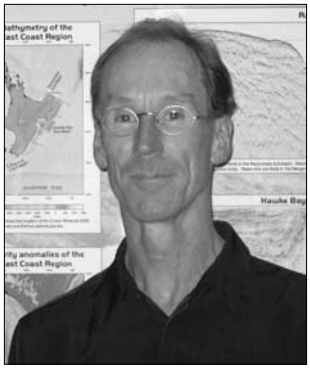
New Zealand's continental shelf submission is based on article 76 of The Convention. The ten paragraphs of this article affirm that the legal continental shelf extends at least 200 nautical miles from the continental baselines (essentially the coastline), and describe how countries are able to define the outer limits of their continental shelf where it extends beyond that distance. Once defined, countries have sovereign rights over living and non-living resources that lie on or beneath the seabed of their legal continental shelf. Petroleum, minerals and benthic organisms are included in the terms of the article, whereas resources in the water column such as fish are not.

The size and complexity of New Zealand's offshore region established the magnitude and extent of the submission. New Zealand's territorial sea (the ocean area within 12 nautical miles, about 22 km, of the coast) and Exclusive Economic Zone (EEZ; the ocean area within 200 nautical miles, about 370 km, of the coast) cover an area of about 4 million square kilometres. The area of legal continental shelf as described in New Zealand's submission to the CLCS is of the order of 1.7 million square kilometres. This means that when the submission is accepted, the area of seabed over which New Zealand has rights will increase by almost 50%, and that about 96% of the New Zealand continent is under water.

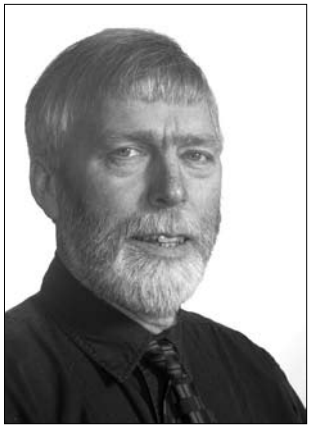
The submission is 2683 pages long, and includes 72 charts, 90 seismic sections, and 4 CD/DVDs of digital data. It is a landmark piece of work, providing a comprehensive summary of the morphology, geology, and tectonic history of some of New Zealand's more remote offshore regions. In the next sections we give some details of the New Zealand project, its context and a few examples of the types of regions/data that contributed to the outcomes for both UNCLOS and research.

New Zealand's continental shelf project

The continental shelf project was led by Land Information New Zealand (LINZ). LINZ managed the survey programme; the collection, processing, analysis, and interpretation of data; and production of the final submission document for the UN.



Ray Wood is Section Manager of the Ocean Exploration group at GNS Science, Lower Hutt. Ray joined the former DSIR in 1979. His research interests include the tectonic evolution of the Southwest Pacific, hydrocarbon maturation and migration modelling, data analysis using geographic information systems, and the application of geophysical techniques to fishery research. Since 1994 he has helped lead the technical team providing advice to New Zealand's Continental Shelf Project, and is currently helping several other countries write their continental shelf submissions. He was the Technical Director of an IT startup, developing tools for the television and video industry. Ray may be contacted at R.Wood@gns.cri.nz



Bryan Davy is a marine geophysicist employed with GNS Science since 1982. He has been involved in most aspects of regional marine, inshore and freshwater geophysics, from equipment design and construction to data acquisition, processing, and interpretation. He has often been Project Leader in the many scientific and commercial investigations he has undertaken surveying in the New Zealand EEZ, Antarctica, and the shallow inshore, harbour, and lake environment. Bryan's principal research interests involve the Cretaceous transition of New Zealand from a convergent component of the Gondwana margin, through crustal extension and basin development, to eventual seafloor spreading between New Zealand and Antarctica. High-resolution, often small boat-based, seismic reflection surveys led by Dr Davy have examined volcanic evolution in the Central Volcanic Region calderas as well as features of the Auckland Volcanic Field. Dr Davy is a leading technical consultant on New Zealand's UNCLOS continental shelf delineation.

The Institute of Geological and Nuclear Science (GNS Science) and the National Institute of Water and Atmospheric Research (NIWA) provided most of the scientific expertise for the project. The Ministry of Foreign Affairs and Trade (MFAT) provided legal advice on the interpretation of article 76 to guide the preparation of the submission and are leading the discussions with the CLCS. MFAT has also been responsible for the international boundary negotiations that are part of the process of defining the limits of the continental shelf. The Ministry of Economic Development (MED) archived much of the data collected by the project, and Iain Lamont, recently retired from the Hydrographic Office of the Royal New Zealand Navy and one of the inaugural members of the CLCS, provided strategic and technical advice to the project.

There were three phases to the continental shelf project. The first phase, the desktop study, collected all existing bathymetric (single-beam and multi-beam swath), geological (dredge and core samples), and geophysical (seismic reflection, seismic refraction, gravity anomaly, magnetic anomaly) data. Most of these data were gathered by New Zealand and overseas research and industry surveys, and are held by New Zealand research and government bodies (GNS Science, NIWA, LINZ, MED). These data were assessed for their usefulness for supporting New Zealand's submission to the CLCS, and additional surveys were recommended to fill gaps in existing data coverage.

The second phase of the project gathered and processed the required bathymetric, geological, and geophysical data. Bathymetric data were collected in areas where more knowledge of the shape of the sea floor was needed to demonstrate morphological connection with the New Zealand land mass. Geological and geophysical data, especially seismic reflection data, were collected where more knowledge of the nature of the rocks at and beneath the sea floor was needed to demonstrate a geological connection with the New Zealand land mass. Optimum definition of the legal continental shelf would have required complete bathymetric mapping of the sea floor, regularly spaced seismic reflection lines to image the subsurface geology, and comprehensive rock sampling across the continent–ocean transition zone to obtain hard evidence to constrain the interpretation of the other data. Such a thorough approach, adopted by at least one other country, was unaffordable for New Zealand.

Instead, data were collected along carefully chosen tracks to determine the extent of the natural prolongation of New Zealand's land mass according to UNCLOS definitions. Because so little was known about much of New Zealand's offshore region, the choice of the location of many of these lines had to be guided by analysis of satellite-derived gravity anomaly data that provide a complete coverage of the region. Satellite gravity data indicate broad aspects of the bathymetry and geologic structure, but their resolution is of the order of 3–5 km, not sufficient to map either the bathymetry or geology in detail. Thirteen surveys were carried out using New Zealand and foreign vessels to collect about 20 000 km of seismic data, 70 000 km^2 of multi-beam swath bathymetry data, gravity and magnetic anomaly data, and rock samples from targeted sites.

The data analysis and interpretation in the third and final phase focused on demonstrating continental prolongation, and was based on guidelines published by the CLCS. In most cases this involved mapping the sea floor morphology, interpreting the subsurface structure of the basement rocks, determining sediment thickness, and integrating all of these analyses into a coherent description of the present day configuration of the continental margin along with a cogent account of its tectonic evolution. The culmination of this phase was a written submission that was lodged with the CLCS at the United Nations in New York on 19 April 2006. This submission is currently under consideration by the CLCS. Once that process has concluded, New Zealand will be able to formally define the outer limits of its legal continental shelf in precise geographical terms for the first time under international law.

Article 76 of the UN Convention on the Law of the Sea

The outer limits of New Zealand's legal continental shelf, as described in the submission to the CLCS, are determined according to the terms and formulae contained in article 76 of UNCLOS. The fundamental principle of article 76 is that the continental shelf is the submarine prolongation of the land mass of a coastal State. Determination of prolongation is based on an assessment of morphological and geological connections between the land mass and the sea floor.

Where the continental shelf extends beyond 200 nautical miles, about 370 km, from the baselines of the territorial sea, article 76 provides two formulae to determine the outer edge of the continental margin: either by fixed points located 60 nautical miles, about 111 km, from the foot of the continental slope, or by fixed points where the sediment thickness is at least 1% of the shortest distance to the nearest foot of the continental slope position (Figure 2). The article also provides two constraints on the outer limits of the continental shelf: either 350 nautical miles, about 650 km, from the baselines of the territorial sea, or 100 nautical miles, about 185 km, from the 2500 metre isobath (Figure 2).

Application of the apparently simple principles in article 76 is not straightforward. The terms and formulae in article 76 have morphological, geological, and legal contexts, and can be interpreted and applied in several ways. The complexities of sea floor morphology and geology in the real world also contribute to this uncertainty. Practical challenges arising from these issues include a choice among several possible foot-of-slope positions on margins with considerable irregular bathymetric relief, and demonstration of prolongation and connection to continental fragments on rift margins. Similarly, deciding whether a feature is a 'submarine ridge', an 'oceanic ridge' or a 'submarine elevation' that is 'a natural component of the continental margin' (none of which are defined in article 76) can have enormous impact on the area of the legal continental shelf.

Examples of data collected from the continental margin

As well as confirming New Zealand's rights over a large area of the sea floor, the project has had, and will continue to provide, significant input to research projects that will generate economic and social benefits to New Zealand.

Survey lines were orientated to best determine the extent of the New Zealand legal continental shelf. Survey lines that maximise the value for the project are often aligned along basement

highs and sedimentary basins, and are not ideal for unravelling the three-dimensional structure and tectonic history of the region, or assessing its resource potential. Nevertheless, most of these bathymetric, geophysical, and geological measurements and observations are from remote, virtually unsurveyed parts of New Zealand's offshore region. They will make an enormous contribution to the fundamental understanding of the region as they are integrated into on-going projects. The deep crustal seismic surveys (c. 10 000 line km), imaging the geology up to 20 km beneath the seafloor, revealed significant information about the structure and evolution of the crust around New Zealand (e.g., seismic line HKDC1; Figure 3).

For example, several surveys collected bathymetry, seismic reflection, gravity, and magnetic data across the Hikurangi Plateau, a large igneous province north of the Chatham Rise. These data (Figure 3) show the structure of the volcanic basement of the plateau for the first time and the relationship of it with the rest of New Zealand.

Until about 80 million years ago, New Zealand was part of the large continent of Gondwana. At its greatest extent Gondwana also included Australia, Antarctica, South America, Africa, Madagascar, Arabia, and India. Figure 3 shows a fossil subduction zone in the New Zealand sector of the Gondwana margin, linking the Hikurangi Plateau to the continental rocks of the Chatham Rise, and the northern boundary of the legal continental shelf with oceanic crust of the Southwest Pacific Basin. Understanding the dynamics of the subduction of the Hikurangi Plateau, and the transition to New Zealand–Antarctica–Australia breakup, is the key to understanding the formation and structure of many of New Zealand's rifted sedimentary basins. These basins are prime targets for oil and gas exploration.

The Resolution Ridge System is another example of an area that was extensively surveyed by the UNCLOS project. The segments of the ridge system extend southwest from Fiordland for more than 550 km (Figure 4). Several surveys collected rock samples, swath bathymetry, seismic reflection, gravity and magnetic anomaly data, and showed that most of the ridge is composed of oceanic crust and therefore does not form part of New Zealand's continental shelf. However, further analysis of the data is providing important insights into the breakup of Gondwana 80 million years ago (separation of New Zealand, Australia, and Antarctica), and the development of the modern plate boundary through New Zealand (40 million years ago to the present).

Implications for the future

The data collected for the UNCLOS project are a substantial addition to data collected in New Zealand's offshore region. They have fulfilled the primary goal of establishing the outer limits of New Zealand's legal continental shelf. Integration of these data into on-going projects exploring fundamental questions about New Zealand's territory (e.g. the structure and history of the seafloor and the rocks beneath it, the distribution of habitats and resource potential, and implications for environmental diversity, climate change, and plate tectonic processes) will benefit New Zealand and global science for decades.

Management of marine resources is one of the challenging tasks that will benefit from these data. Sustainable, environmentally responsible management of the offshore that is capable of producing informed decisions among competing demands on marine space will require comprehensive knowledge of the resources, their interaction with the physical processes that formed them, and their relationships with the environment.

The marine area under New Zealand's jurisdiction extends from the subtropics to the Antarctic. This region almost certainly hosts extensive deposits of a variety of valuable resources, but very little of it has been adequately surveyed, and the location and extent of prospective areas are largely unknown. These resources may be biological or mineral in origin; in this report we focus on potential mineral resources.

The potential size of these resources could have a huge impact on New Zealand's economic future. The potential of the legal continental margin was quickly recognised by Australia, whose economic prosperity has been driven in recent decades by the development of its onshore natural resources. Following the settlement of a boundary with New Zealand in 2004, Australia has embarked on an active programme to promote petroleum exploration in their sector of Lord Howe Rise, a frontier exploration area identified by their UNCLOS project (Kroh *et al.* 2007).

The current value of offshore mineral production to New Zealand is about $750 million, most of which comes from oil and gas (Statistics New Zealand 2006). Oil and gas production in 2002 contributed about 0.7% to the New Zealand economy. Oil exploration has been under way for over a century, but on a global scale New Zealand is still under-explored.

Frontier petroleum basins cover an area of about 55 000 km^2 and may be capable of generating as much as 24 trillion barrels of oil (Uruski & Baille 2001). Many explorers believe that it is likely that Maui-sized reserves will be found in the offshore. If another Maui gas field was discovered today it would be worth of the order of NZ$50 billion. When considered in the context of global energy and carbon markets, it would be a strategic resource that could contribute to a reduction of total carbon emissions.

In addition to conventional oil and gas prospects, New Zealand has the most promising known gas hydrate resource potential in the Southwest Pacific. Gas hydrates are an enormous potential source of CO_2-efficient energy. The total volume of recoverable gas from gas hydrate deposits along the East Coast could be of the order of 813 TCF (trillion cubic feet), of which perhaps 20 TCF may occur as concentrated deposits (Pecher & Henrys 2003). The total gas hydrate resource off the East Coast could be worth almost NZ$4 trillion, or NZ$180 billion in accumulations that may attract development interest in the short- to medium-term.

Other non-living marine resources in the New Zealand region include minerals formed or concentrated by physical, chemical, and hydrothermal processes. Phosphorite deposits on the Chatham Rise are estimated to be worth $3–4 billion, but are not economic because alternatives are still relatively inexpensive. The most extensive known manganese nodule deposits in the New Zealand region are in the deep ocean southeast of the Campbell Plateau. At current prices this resource is worth more than US$300 billion (Graham & Wright 2006).

Exploration for massive sulphide deposits is under way along the Kermadec Ridge north of New Zealand. Vents of hot, mineral-rich water are associated with some of the volcanoes

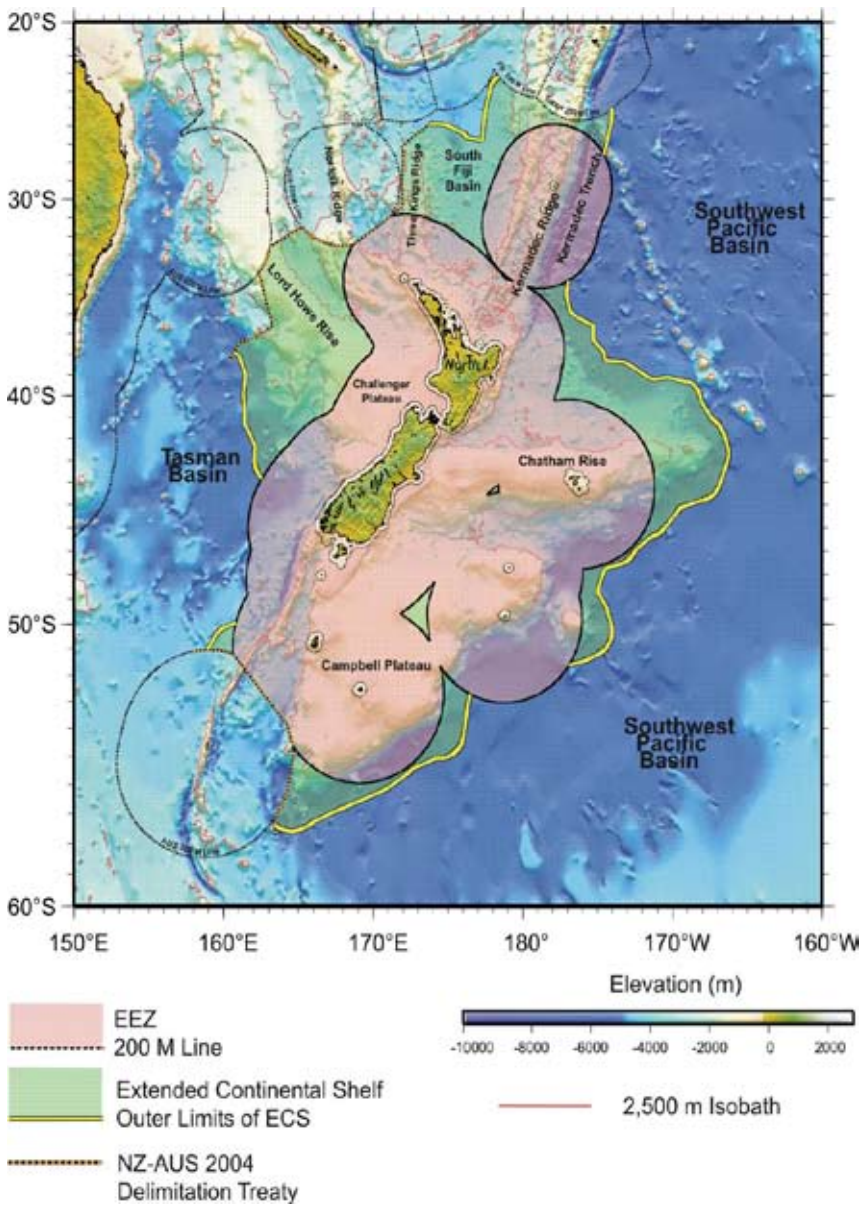


Figure 1. Shaded bathymetric map of the New Zealand region, illuminated from the northeast, showing the EEZ (red shading) and possible extent of New Zealand's legal continental shelf (green shading). The outer limits of the legal continental shelf remain subject to consideration by the Commission on the Limits of the Continental Shelf and to the delimitation of boundaries with Fiji, Tonga, and possibly France.

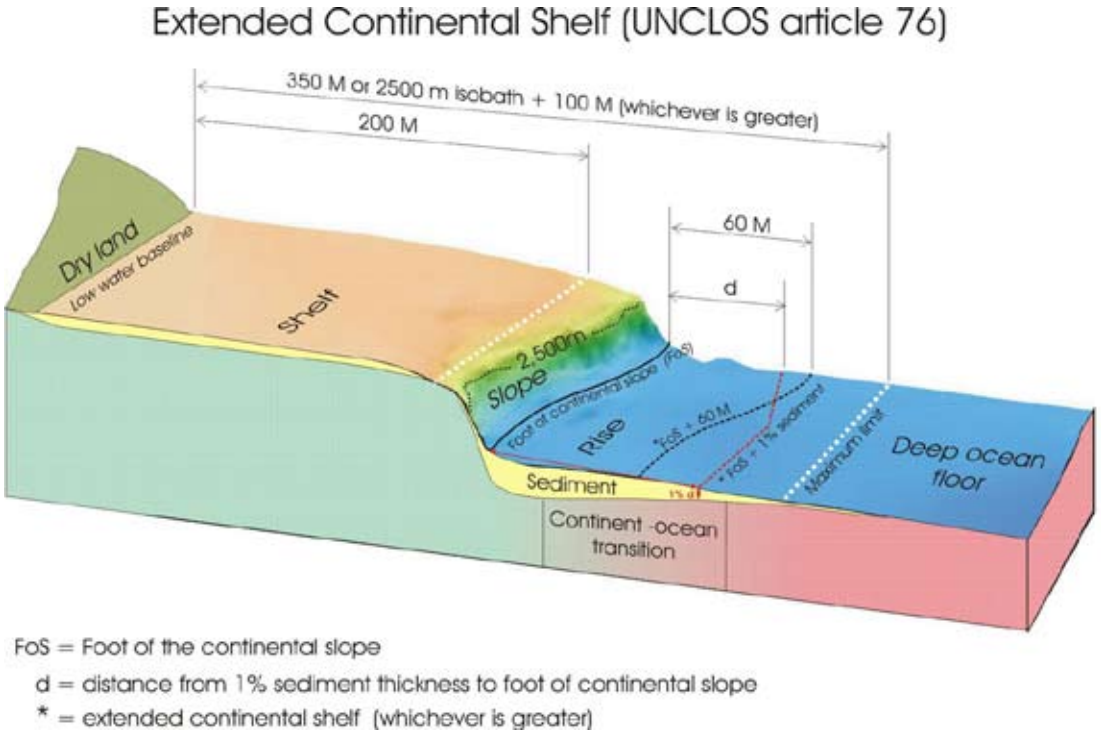


Figure 2 (below). Cartoon showing a hypothetical continental margin, summarising the formulae and constraints described in article 76 that determine the outer limits of the continental shelf (modified from Kapoor & Kerr 1986).

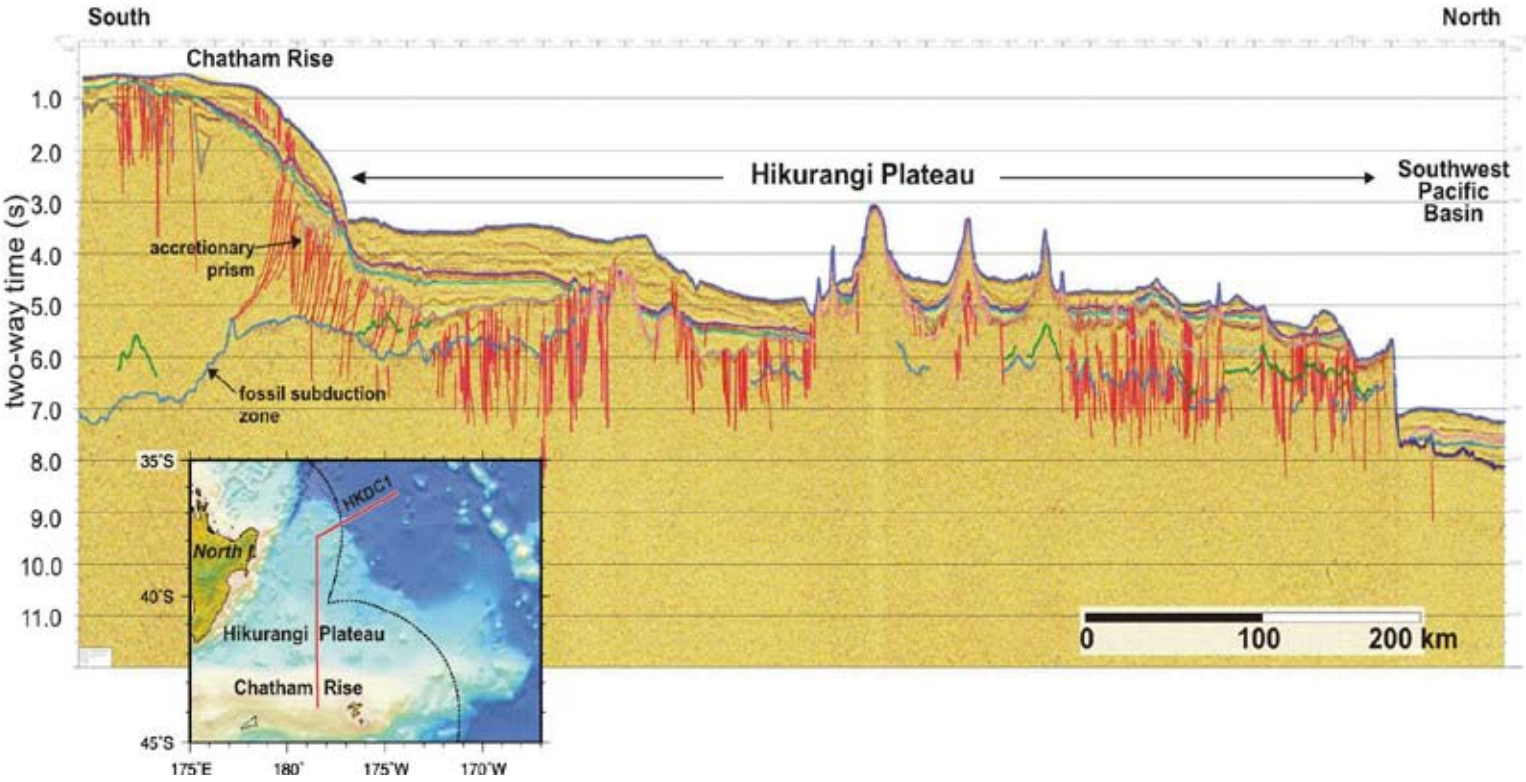


Figure 3. Line HKDC1 across the Hikurangi Plateau showing the accretionary prism and fossil subduction zone at the Chatham Rise margin. The red lines are faults. One second two-way travel time (TWT) in water is approximately 750 metres. One second TWT in sediments is approximately 1000 metres.

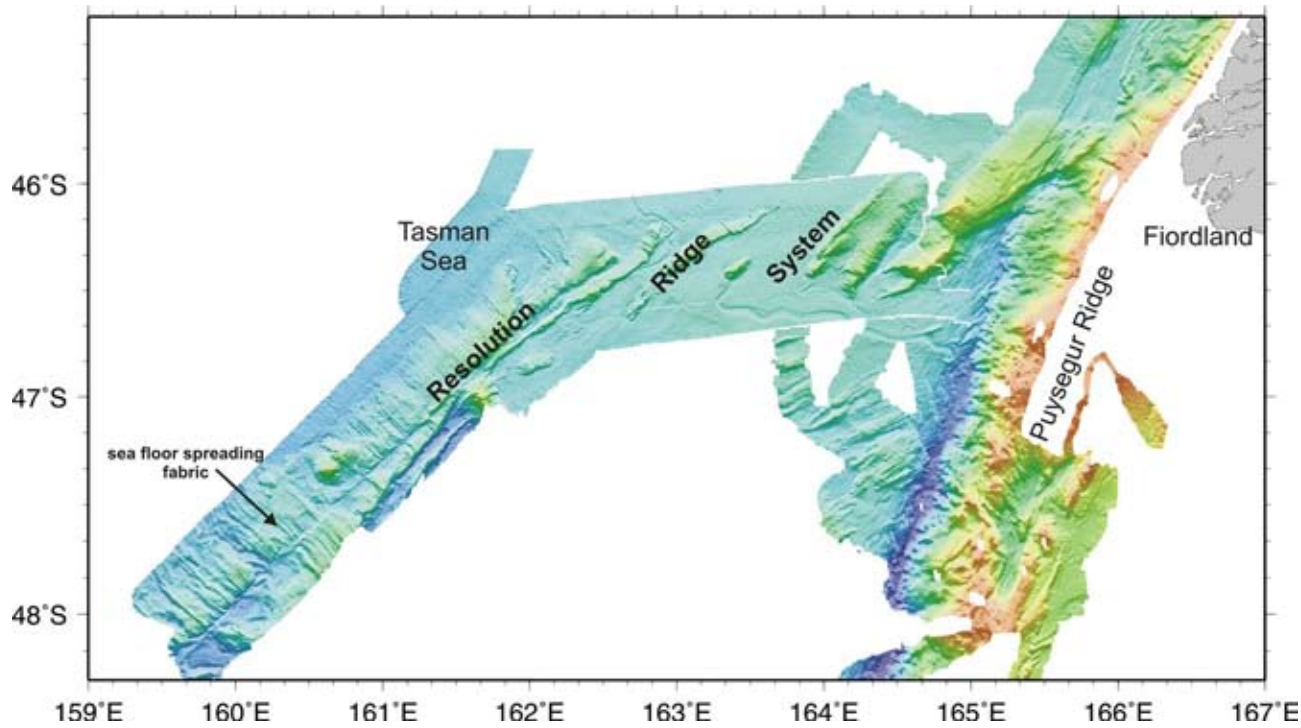


Figure 4. Shaded image of swath bathymetry data from the Resolution Ridge System, illuminated from the northwest. Deep areas are blue and green, shallow areas yellow and red. The orthogonal pattern on the sea floor, particularly in the southwest, is the product of sea floor spreading.

along the arc, often referred to as 'black smokers'. When the hot water meets the cold sea water the metals and other compounds dissolved in the thermal fluids precipitate and form mineralised chimneys. Some of these have been recovered and analysed; the metal content of a single chimney could be worth several thousand dollars. Of more interest is the possibility that the flow of these thermal fluids in the seafloor rocks could result in widespread mineralization and large deposits of high-grade ore. The world's giant lead-zinc deposits all formed in a marine hydrothermal environment like those active today along the Kermadec arc. A deposit of this size would also be worth billions of dollars.

Sustainable, environmentally responsible management of the offshore requires knowledge of ecological diversity and vulnerability, and of the risks and rewards associated with development. The current lack of knowledge may unnecessarily threaten the marine environment or restrict development. The resources described above are not being developed because of economic (e.g. perceived risk of exploration, competition with onshore resources, cost of offshore operations) and regulatory factors (e.g. uncertainty about environmental regulations and impacts). The need for knowledge is only going to increase as increasing global demand and development of new technologies drive interest in use of the offshore.

The way forward for responsible management of the offshore is to invest in systematic surveys to map the sea floor and subsurface and provide the framework for analysis of benthic environments and assessment of resource development.

With apologies to Winston Churchill, the data collected for the UNCLOS project are not the end, or even the beginning of the end in terms of surveying New Zealand's offshore region. But they may mark the end of the beginning. The results show what commitment to a project can achieve, and hint at the rewards that would accrue from a similar commitment to the on-going exploration of the offshore.

References

Graham, I.J.; Wright, I.C. 2006. The Campbell ferromanganese nodule field in the southern part of New Zealand's exclusive economic zone. Pp. 339–347 in: Christie, A.B.; Brathwaite, R.L. (Eds) Geology and exploration of New Zealand mineral deposits. *AusIMM monograph 25*.

Kapoor, D.C.; Kerr, A.J. 1986. *A guide to maritime boundary delimitation.* Toronto: Carswell.

Kroh, F.; Morse, M.P.; Hashimoto, T. 2007. New data on Capel and Faust basins. *Preview, Australian Society of Exploration Geophysicists*: 130.

Pecher, I. A.: Henrys, S. A. 2003. Potential gas reserves in gas hydrate sweet spots on the Hikurangi Margin, New Zealand. *Institute of Geological & Nuclear Sciences science report 2003/23.* 32 p.

Statistics New Zealand 2006. New Zealand's marine economy 1997–2002. Environmental series. 31 p.

Uruski, C.; Baille, P. 2001. Petroleum potential of New Zealand's deep water basins. Pp. 151–158. in: Hill, K.C.; Bernecker, T. (Eds) Eastern Australasian Basins Symposium, 25–28 November 2001, Melbourne, Victoria, *Australasian Institute of Mining and Metallurgy. Special publication/Petroleum Exploration Society of Australia*.

Acknowledgements

We are grateful for comments by Dr Fred Davey[1], Dr Hamish Campbell[1], Elana Geddis[1], and Alice Revell[2]; and for permission from LINZ and MFAT to publish this article.

The UNCLOS project is a team effort, and we particularly want to acknowledge the contribution of Dr Ian Wright[1], Dr Vaughan Stagpoole[1], Dr Phil Barnes[3], Dr Rick Herzer[1], Dr Dan Barker[1], Dr Geoffroy Lamarche[3], Kevin Mackay[3], Arne Pallentin[3], Russell Turner[1], Jerome Shepherd[4], Nigel Fyfe[2], Anna Broadhurst[2], Elana Geddis[2], Gerard van Bohemen[2], and Alice Revell[2].

1 Institute of Geological and Nuclear Science (GNS Science)
2 Ministry of Foreign Affairs and Trade (MFAT)
3 National Institute of Water and Atmospheric Research (NIWA)
4 Land Information New Zealand (LINZ)

Article

An inordinate fondness for spiders

Simon D Pollard
Canterbury Museum, Rolleston Avenue, Christchurch

It was a great pleasure to be recognised by the New Zealand Association of Scientists for my contribution to the public understanding of science, which I believe is an integral part of the privilege of being a scientist. When my proud father saw the award, he asked to hang it on his living room wall, and this is a very appropriate place for it to be hanging, as the family home is where my fondness for animals and natural history began. Aside from an early lapse of judgement at three, when I asked my mother to cook some woodlice for my tea, I have been thoroughly fascinated with the lives of all animals, great and small. Two years after the 'woodlice incident', my interest was less culinary and more metaphysical when I asked my Uncle Jim, who was an animal psychologist at the University of Canterbury at the time, whether bees thought in English. It was very confusing to me that they didn't, but that and many other conversations with him convinced me from the age of seven to become a zoologist. Around this time, like many young boys and girls, I developed a fascination with things that go bump in the night and other horror stories. Luckily, my uncle didn't just know about animals, he also introduced me to the classics of Dracula and Frankenstein. However, at the age of nine or ten, my desire to write a story for school on the origins of Frankenstein was quickly squashed by my mother, who declared that a story on African mammals was much more appropriate. Still, my gothic sensibilities could not be restrained and, at the age of twenty, while I was studying at university, a particular group of animals caught my attention.

It was early 1977, my fourth year at university and my first entomology lab. We were told to make a collection of insects or spiders. The seed sown all those years ago suddenly came to fruition that day and spiders became my obsession. They were the quintessential creatures of the night, and the fact that Dracula never had his castle spider-proofed added immensely to their appeal.

This article is an expansion of the address given by Dr Pollard upon receipt of the Association's 2007 Science Communicator Award at Science House, Wellington – *Editor.*

While my uncle was a very important early influence, it was the arrival at Canterbury University of an American zoologist in 1978 that was to have the biggest influence on my life and career. In March 1978, Robert Jackson, a spider biologist from the USA joined the staff at the University of Canterbury and took me on as the Spiderman's apprentice. Robert has been my teacher, colleague and friend for 30 years and has contributed hugely to the opportunities and experiences that being a spider biologist have given me.

Looking back it is funny to think that the following questions would become relevant to my life: How could my first article in *Natural History* magazine lead to me extracting spider vomit for a living? Why would the Sri Lankan press accuse Robert and me of smuggling tarantulas out of their country to make nerve gas for the US military? Why would a man at Heathrow come up to me and say, 'I have come for the ants'? What was I doing with 13 live tarantulas in an aeroplane bathroom during a flight from Los Angeles to Auckland?

But first, what did my PhD topic have to do with Count Dracula?

Leaving only fang marks, crab spiders drain their victims more thoroughly than any vampire, and not surprisingly they were the subject of my PhD. Using a microbalance that could weigh down to a 10 millionth of a gram, my research was on understanding how these small spiders, with an average body size of 5 mm, extracted precious bodily fluids from their prey and how the mechanics of this process were influenced by changes in their victim's body as they were drained. In a broader sense, the spiders were tools to understand how changes in prey influenced the evolution of foraging strategies and how these changes should be incorporated as variables in mathematical models predicting optimal foraging behaviour. As a sideline, through my research I was able to make predictions about how long Dracula should feed on a buxom peasant before the costs of extracting blood outweighed the benefits and it was time to look for a new peasant! Though I have never published my results…

Simon Pollard is curator of invertebrate zoology at Canterbury Museum, and an adjunct associate professor in the School of Biological Sciences at the University of Canterbury. Dr Pollard has contributed widely to the public understanding of science through talks to community groups, including Probus Clubs, U3A, WEA, schools, Christchurch Polytechnic, Continuing Education programmes at the University of Canterbury and outreach programmes at schools, and as a regular contributor to the 'Ask a Scientist' column syndicated to New Zealand newspapers.

He may be contacted at simon.pollard@canterbury.ac.nz

It was during my PhD that my skills as a scientific and popular writer developed, as well as my enjoyment in giving talks to peers and the public. I am particularly proud of one of my sentences in a co-authored book chapter on chemical communication in spiders that was written around this time. The sentence was an attempt to say tastefully that the males of a particular spider are so horny that they will try to mate with females – even when they are dead:

'Necrophilic males are thwarted by the tendency of their lifeless companions to tumble over on their backs before the mating position can be assumed'.

At one talk to mainly older women, I was explaining how spiders are fluid feeders and really have a soup diet. My attempt to make my usual witty remark about spider food being similar to that found in a rest home changed in a heartbeat to it being like baby food, when I saw that a very old woman in the front row was looking at me through a pair of binoculars! I suspect that my ease with public talking came from my uncle and his father, who were both very enthusiastic lecturers.

As the old saying goes, a picture is worth a thousand words, and nothing could be truer when it comes to telling stories about the lives of spiders. An opportunity to learn about natural history photography came soon after my PhD was completed, when I was an assistant for a *National Geographic* photographer, Mark Moffett, who was photographing an article on jumping spiders (which Robert Jackson was writing). For four months in New Zealand and Australia, Mark taught me what made interesting spider photographs and for most of that time, the idea of actually taking close-up photographs never entered my mind. All that changed when I looked through the viewfinder of his camera and brought into focus the world from a spider's perspective for the first time. It was a world that had me hooked, and maybe it was a good omen that one of my photographs of Mark and Robert under a large spider web was used in the article.

While Mark had fantastic skills and the best equipment money could buy, my first attempts at close-up photography were with a mixed bag of gear. Although my knowledge of film stocks, lenses, and lighting was minimal, my early photographs showed what was possible. Sometimes I even got it right and one of my earliest photographs was recently used on the back cover of one of my books co-authored with an American writer.

But it was the chance to visit the Antipodes Islands in the subantarctic that really got me started in natural history writing and photography. These islands were considered the jewels in the subantarctic's crown and this was to be the fourth expedition to them during the 20th century. Two close friends who had been doing PhDs in zoology at the same time as me were subantarctic fanatics and their enthusiasm for the trip reinforced how special it was to be part of the expedition. It was a wonderful experience and five years later in an article for *Natural History* magazine I wrote:

As our small inflatable boat approached Antipodes Island, I was reminded of the first time The Beatles landed in the USA. In February 1964, thousands of screaming fans lined the tarmac of JFK Airport in New York to welcome The Beatles. In October 1990, as I stepped onto the narrow, rocky beach on the north shore of Antipodes Island, I was confronted by a phalanx of seabirds lining Anchorage Bay like a wild and welcoming crowd. A deafening cacophony assaulted my ears as thousands of erect-crested and rock hopper penguins, squawking and fighting, burst forth in a chorus of stuttered screams. Light-mantled sooty albatrosses cried out like crazed soloists. From the mammal section was the low, guttural bellow of disgruntled elephant seals. The whole choir of the Antipodes barked its discordant message.

Soon after returning from the Antipodes, I wrote to *New Zealand Geographic* magazine to see whether they would be interested in an article on the expedition. In my letter were copies of some of my slides, including close-ups of jumping spiders. They replied to say that they had just run an article on the Campbell Islands in the subantarctic, but did I want to take photographs for an article on New Zealand spiders. A great deal of thanks is owed to Kennedy Warne, then editor of the magazine, for giving me this opportunity. The magazine supplied all the film and, with my shiny new Nikon close-up gear, I started to learn how to take interesting photographs. My living room at home was my spider studio and it was home to a large number of eight-legged models. My first written piece for a widely-read magazine also featured in the article and it was on spider myths and legends. A reference to Count Dracula appeared in the second paragraph!

Luckily, Australasia's *Geographical Magazine* did want a story on the Antipodes. In fact, it was one of my non-spider photographs that convinced the editor to take my story. The photograph should have been of a penguin drinking from a rock pool. Soon four parakeets camouflaged by vegetation next to the penguin came into view. Moving back to include everybody in the photograph, I was about to push the shutter when a baby fur seal popped up from behind a rock above the parakeets, saw me and ducked down again. Luckily, the seal made it onto the slide. When the photograph was published in the magazine, the top of the slide above the seal was cropped. Almost 15 years later, the photograph was enlarged full-frame and used in an exhibition, and two previously unseen animals appeared; a small bird called a pipit in the top left hand corner and a seal draped over a rock in the top right. No wonder people accused me of using stuffed animals!

Of course in the early 90s many scientists saw popular writing as the intellectual pygmy of peer-reviewed publications, and it was publish or perish rather than publish and popularise. One scientist even told me that popular science writing was easy – you just take your published papers and leave out the big words! I'm sure his stories would have been a drug-free way to cure insomnia.

I left New Zealand in mid-1991 to take up postdoctoral fellowships at the University of Virginia, the University of Alberta, and Cambridge University. My confidence as a photographer and writer grew, but it seemed unimaginable that a year and a half later a prestigious photographic agency in New York would be representing my photographs and my first article for *Natural History* magazine in New York would be accepted. Even more unimaginable was that in 1994 the National Museum of Natural History in Washington DC and the American Museum of Natural History in New York were flying me out from New Zealand to give workshops on natural history photography. A number of my photographs also appeared in an exhibition on spiders that toured the USA and Canada for four years. Marvel Comics was the sponsor and they would fly me out from New Zealand to give one hour talks on spiders. A two-page spread

of my spider photographs also appeared in Spiderman Comics as if Peter Parker had been dabbling in spider photography. It was almost too much for a local boy from Christchurch to cope with. Almost!

When my first story appeared in *Natural History* magazine, it was so pleasing to see it published with my photographs, that it was months before I noticed that it was the cover story with the title Vampire Spiders! The story had been on my crab spider research in New Zealand and at the University of Virginia and somebody who read it was about to take my life down a rather strange path. I was about to go to the Philippines when somebody contacted me from a biotech company and asked whether I would come to San Francisco to talk about spider vomit. My fellowships were coming to an end, and looking for a university position was the next step. Instead, I returned to New Zealand to extract spider digestive fluid for three years. It was fantasy money and gave me lots of time to travel, lecture, write, and take photographs. I am probably one of few people who would deliberately fly from Los Angeles to New Zealand via Singapore, but it allowed me to take natural history photographs in Singapore and Malaysia's many parks and reserves.

Other stories for *Natural History* magazine followed, including ones on: ant-mimicking jumping spiders from the Philippines, where the males have sword-like mouthparts; the Antipodes; spiders from the biggest bat cave in Borneo; and spitting spiders from the Philippines. I have been writing and illustrating articles for the magazine for 15 years, and a 2007 story, co-authored with Robert on our Marsden-funded work in Kenya on blood-drinking spiders, was called 'The Vampire Slayers of Lake Victoria' and made references to Dracula, Frankenstein and werewolves! With my many research trips to Asia and Africa over the years, I have a virtual arsenal of natural history stories that have been included in many articles and lectures.

Having a profile as a scientist popularising natural history also led to me advising on a number of natural history documentaries and even co-writing a script for David Attenborough. For 'Spiders from Mars', Robert and I collected spiders in Sri Lanka and I travelled with the spiders to Bristol for filming. Unfortunately, the Sri Lankan Government thought we were smuggling spiders out of the country, and the story became so distorted by the Sri Lankan press that it ended up in the papers as the tarantula nerve gas scandal mentioned earlier. When I arrived at Heathrow, a man of few words came up to me and said, 'I have come for the ants'. In my suitcase were two nests of extremely angry ants, and the BBC had sent him to pick them up. They were handed over as discreetly as possible and, before I could say anything to him, he and the ants had disappeared into the crowd. While the ants were in my check-on luggage, fifty small jumping spiders that were about to become movie stars in the documentary were in my carry-on luggage. During the flight I decided to make sure the spiders were all right and opened a vial to check on its resident. He promptly ran up my arm and I had to feign some ghastly neuromuscular calamity to retrieve the spider, so as to convince my neighbour that a spider had not just escaped on the plane. Still, I did have quite a lot of experience with spiders on planes, and the year before, thirteen live tarantulas rested in my case in the overhead locker. During the flight they were watered in the bathroom and their photograph was taken for tarantula posterity. It is an image mostly unimaginable given airline security in a post 9/11 world.

After writing a few articles for *Nature Australia*, one co-authored with Robert and titled 'Tusks, horns, and hairy penises', the editor invited me to write a regular column, and this continued until the magazine folded in 2005. It was such a wonderful time that if I had had to choose between writing and photography, the pen would have been shown to be the mightier opponent indeed. This was mostly due to the editor, Georgie Hickey, whose abilities to polish each story made us both proud each time one was completed.

Various characters from popular culture and literature often popped into my column. The culinary preferences of Hannibal Lecter were mentioned in 'Assassins Who Live with the Dead', a tale about a bug that sucks the insides out of ants and then carries the hollow bodies on its back to attract more ants. Mark Twain's infamous quote about his premature obituary opened 'The Creature from the Deep Lagoon', a story about the discovery of the supposedly extinct coelacanth. One of my favourites was 'Squirming Tentacles of Doom' a story about the champion of mammalian eating competitions, the star-nosed mole, who can gobble down a piece of food in a fifth of a second. It started:

'The Wind in the Willows' opens with the Rat taking his friend and fellow rodent the Mole on a picnic to the riverbank. Mole unpacks the fat, wicker luncheon-basket on a table cloth and spreads out a number of small mysterious packets, which the Rat has explained contain food much loved by Moles. When it was ready the Rat said, 'Now, pitch in, old fellow!' and the Mole unwrapped the food and began to eat in a manner befitting a talking Mole bestowed with English manners and picnic etiquette. However, if the Mole had the eating habits of a Star-nosed Mole, most of the food would have been eaten before the Rat drew another breath

… and finished:

When Kenneth Grahame's Rat tells the Mole what food is inside the wicker basket, the list of goodies rolls off his tongue so quickly, it is easy to imagine that he was actually trying to whet the appetite of a Star-nosed mole. 'What's inside it?' asked the Mole, wriggling with curiosity. 'There's cold chicken inside it,' replied the Rat briefly; coldtonguecoldhamcoldbeef pickledgherkinssaladfrenchrollscresssandwichespottedmeat gingerbeerlemonadesodawater----' 'O stop, stop,' cried the Mole in ecstasies: 'This is too much!' However, life is no picnic for the Star-nosed mole as it races against time to find worms insectlarvaecrustaceanstinyinsects…

I'm sure if at the age of twenty I could have seen inside the picnic basket of my life, I would have to agree with the Mole and say, 'This is too much!'

I would like to extend heartfelt thanks to the New Zealand Association of Scientists for presenting me with the 2007 Science Communicator Award. The encouragement provided by awards such as these is immeasurable.

Select bibliography

Jackson, R.R.; Pollard, S.D. 2007. Bugs with backpacks deter vision-guided predation by jumping spiders. *Journal of Zoology, London 273*: 358–363.

Pollard, S.D. 2007. Spiders and other arachnids. *Te Ara—the Encyclopedia of New Zealand*. http://www.TeAra.govt.nz

Pollard, S.D. 2007. Jewel in the subantarctic's crown. *Journal of the New Zealand Antarctic Society 24*: 62–65.

Pollard, S.D.; Jackson, R.R. 2007. The vampire slayers of Lake Victoria. *Natural History 116*: 34–37.

Review and commentary

The Four Horsemen of The New Enlightenment ride out

Geoff Chambers
School of Biological Sciences, Victoria University of Wellington, Wellington

Introduction

It will seem obvious to many that, if one torments a sleeping giant, one can only expect to suffer damaging consequences. Thus, it may be argued by some that 'intelligent designers' and their kin have taken on such a risk by repeated attacks on Darwinian evolution and the scientific establishment. The long-anticipated response is said to have come from four principal authors via a series of remarkable books. In this article I will present a review of these works by Sagan (2006), Dawkins (2006), Harris (2004), and Dennett (2006). I will go on to argue that these represent more than just a grumpy response for those whose slumbers have been disturbed. Rather they are a concerted scientific and philosophical challenge to the very foundations of theism. Reflecting this view, Barash (2007) has called them *The Four Horsemen of the Current Antireligious Apocalypse*. I will also suggest that they are in the vanguard of a cavalry charge that is The New Enlightenment, rejecting the unreason of religion. This theme echoes Hume (1757) as quoted by Barash (2007) that it is fundamental to consider if religion has an *origin in human nature* v. a *foundation in reason*. Indeed, events seem to have come full circle, and there is a growing body of recent effort that seeks to explain gods and religions as evolutionary epiphenomena.

Four major works reviewed book-by-book

Carl Sagan: *The Varieties of Scientific Experience*

This book was published in 2006, more than ten years after the author's untimely death. It contains the text of the series of Gifford Lectures given by Sagan at Glasgow in 1985 and collected into a single illustrated volume edited by Ann Druyan. The second part of the title is *A personal view of the search for God*. To some this may be a surprising excursion for a cosmologist. Indeed, it is often apparent that when scientists discuss religion, the results are just as dismal as those produced when the religious discuss science. This is not the case here. The lectures are knowledgeable and contain many penetrating insights and telling observations as Sagan presents his view of the relationship between science and religion. The subject is entirely appropriate as the lecture series is devoted to Natural Theology. He elaborates his position with a characteristic sense of wonder at the size and complexity of the Cosmos and does so with great good humour. Carl Sagan is far and away the gentlest of the four authors considered here and is all the more effective for being so. As the main title suggests, he draws on William James' previous Gifford Lectures (1902) that later became his influential book *The Varieties of Religious Experience*, as discussed in Boyer (2001).

The key to Sagan's view is the colossal size and age of the known universe or at least the estimated 4% of it that is presently open to study, given existing technology. The remainder is the hypothetical 'dark matter' and 'dark energy', whose existences are thought by some to explain certain astronomical observations and found necessary to balance their astrophysical equations. It simply beggars his imagination to think that a deity would create something so large and this wonderful just so that humanity could inhabit one insignificant corner of it. From here he asserts that *extraordinary claims* (i.e. all those to the contrary) *require extraordinary evidence*. He then proceeds to a more or less conventional argument for an atheistic worldview and emphasising the lack of explanatory power in supernatural explanations. However, it is interesting that towards the end of his talks he very much gives readers the impression that he enjoys the *feeling of being at home in the Universe* as James (1971) puts it. I think that many New Zealanders today would interpret this as a spiritual concept, and I will say more on this theme later.

Richard Dawkins: *The God Delusion*

Here the title says it all. Dawkins claims that the concept of a God is a not just a *failed hypothesis,* to use Stenger's (2007) descriptor, but also a dangerous one. He makes a strong case that all of the presently available evidence purported to be in favour of pretty much any sort of God is weak at best and commonly illusory. In contrast, and like Baggini (2003), he feels that the evidence against the existence of one or more Gods is overwhelming at least in the sense that more rational explanations are readily available. Again, supernatural explanations are seen as without inferential value because they are consistent with any imaginable outcome, e.g. the death or recovery of a much loved child with a serious illness. In many ways this is only a

Geoff Chambers is Reader in Cell and Molecular Biology at Victoria University. His research speciality is DNA technology applied to projects ranging from human ancestry and health through to biological systematics and wildlife conservation. Dr Chambers lectures on the history and philosophy of evolutionary thought in the BIOL 329 teaching course offered by the School of Biological Sciences, and this is the inspiration for his present article. He may be contacted at geoff.chambers@vuw.ac.nz

re-run of the atheist agenda and one might do better to read a standard text, such as the small volume by Baggini (2003). It would certainly be quicker.

However, Dawkins goes far beyond this conventional ground. He classifies competing viewpoints as either *Deist* (one who believes in a God who just set the rules, established the initial conditions, started things off towards some predetermined end and has sat back ever since then in order to watch developments) or *Theist* (one who believes in an interventionist God who answers our prayers and guides us safely across to the other side of busy roads, etc.). See Figure 1 and Box 1 for the relationships between different belief and non-belief systems. The former position is characteristic of some religions and of modern theological commentators such as Lloyd Geering and John Spong, whose publicly expressed views will be familiar to most New Zealanders. The latter position is characteristic of many popular religions. The gap between the two surely demands some sort of explanation. One imagines that it should be a principal mission of religious office holders to acquire the products of contemporary theology and to share them with their congregations. Others might, and sometimes do, argue that they fulfil this role well enough and that the two scholars named above hold extreme views. I am not equipped to say where the balance lies, but the relative popularity of these competing assertions is potentially measurable for those who might wish to try.

Dawkins and Sagan both recognise the expressed religious views of Albert Einstein as being essentially deist and amounting to nothing much more than worshipping the Laws of Physics! One even more extreme *Deist* position is known as the *Anthropic Principle* (e.g. Barrow & Tipler 1988) or *Goldilocks Enigma* (Davies 2006). In general, this principle holds that the environmental conditions that exist on Earth are so favourable to human existence that they must have been created just so for that express purpose. Thus it is said that a deity really only needs to set values for a small number of physical constants within convivial limits (very small indeed, if one follows Stenger's 2007 arguments) and all will turn out perfectly well. My colleague Jeff Tallon, who has recently written in this journal (Tallon 2007), seems to endorse this view. Dawkins' counter is that the Goldilocks parameters are irrelevant since we are here now and able to discuss them. Some commentators seem to feel that this is circular logic, but I don't think this criticism can be reckoned a fair assessment. The worldly counter-example is that there is only a tiny probability of a golf ball hitting a particular daisy growing in the fairway on your favourite golf course. True enough, but once driven off the tee the ball must land somewhere and you might even find another daisy sitting under it when you go to play your next shot to the green.

Dawkins continues by pointing out that the term *Atheist* is a misnomer, since these thinkers are generally against all forms of supernatural explanation (gods, monsters, witches, and fairies, etc.). More correctly, they are *Phenomenological Naturalists* seeking natural causality for observed events v. *Metaphysical Naturalists*, who would hold that all events have natural causes. In formal terms one can never be certain that absolutely everything does have natural cause, but the gap between these two traditions is still occupied by some pretty big unanswered questions: 'Where did the Universe come from?' and 'How did cellular life arise from pre-biotic conditions?' Those who would erect supernatural explanations as answers to them are said to believe in *The God of the Gaps*. The distance between the two naturalist Schools gets smaller every time a deeply puzzling mystery does turn out to have perfectly normal explanation, e.g. the motions of the planets, etc., and readers can nominate their own special examples. This part of his discussion terminates with Dawkins developing an *Antitheist* position. This holds that religious value systems and practices are necessarily and observably bad things and that indoctrination of the young is

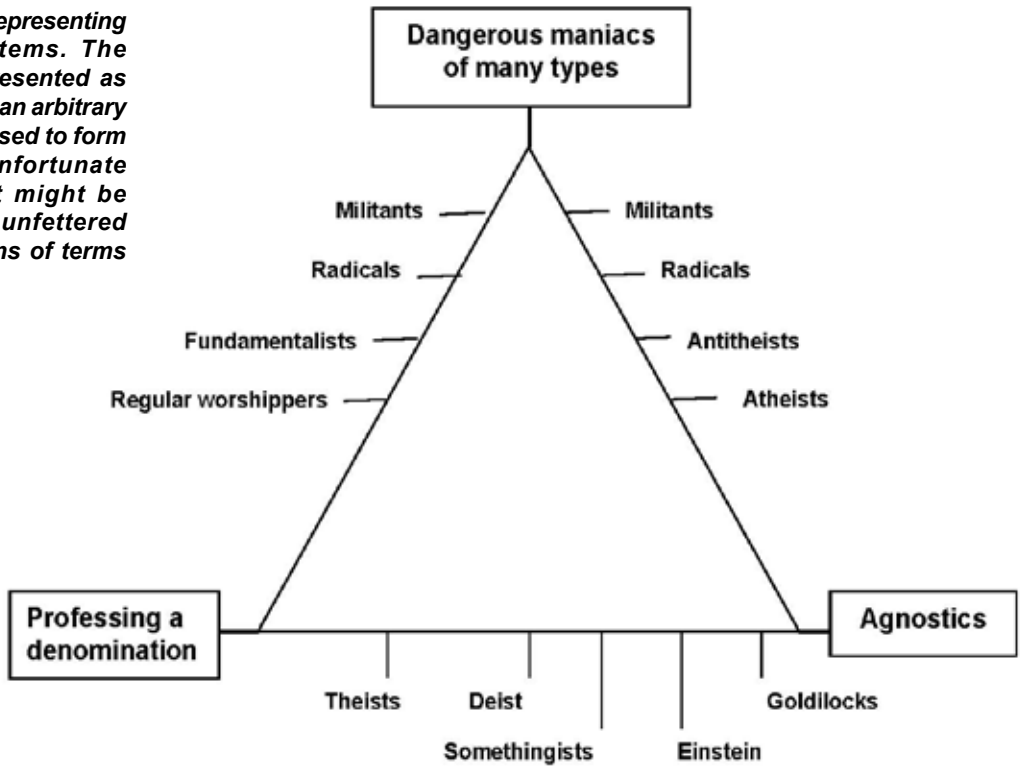


Figure 1: Triangular diagram representing belief and non-belief systems. The extreme viewpoints are represented as ends of a continuum drawn to an arbitrary scale. The scale has been closed to form a triangle reflecting the unfortunate similarity of outcome that might be anticipated if either gains unfettered political power. For definitions of terms see Box 1.

Box 1: Explanation of labels applied to believers and non-believers

These labels are intended to self-explanatory and mostly follow definitions and descriptions given by Dawkins in Chapter 2 of the *The God Delusion*.

Denominated: Those who are willing to sign Church of England, etc., on the official forms but don't actually say their prayers at night or go to church, etc., on Saturday or Sunday, etc.

Theists: People who believe in an interventionist deity.

Deists: They hold that one or more God(s) exist but do not influence our lives or daily events in general. Their form of deity is said to have *wound up the clock and left it to run* or just *thrown out the first ball at the World Series,* etc.

Somethingists: Claim not to believe in God *per se*, but hold that *there must be something out there to explain all this*.

Einstein: An extreme form of Deism (often unacknowledged) that attributes the happy disposition of the circumstances of our environment and universe to some higher organising power – often called *nothing more than worship of the Laws of Physics*.

Goldilocks: Likes everything *just right* so the fundamental constants of Physics must be set at values to ensure that the universe is *not too hot and not too cold*. This is an extreme form of the Einstein position.

Agnostics: Those that have put it all in *the too hard basket.* This is often referred to as the only intellectually tenable position. In contrast, Dawkins seems to see them as just intellectually lazy cop-outs.

Atheists: Methodological naturalists tending towards metaphysical naturalists.

Antitheists: Those who, like Dawkins, Harris, and Hitchens, believe that religion is necessarily a bad idea and leads to poor if not downright evil consequences. The opposite benign outcome is claimed for atheism by Dawkins, but the case remains to be made convincingly.

a form of poorly disguised child abuse. Others, including Harris (2004, 2007) and Hitchens (2007), have elaborated on this theme and show how such belief systems can produce seriously evil outcomes.

The second major contribution of this work is to clarify and popularise arguments for evolutionary origins of religious beliefs. In short, if man invented God rather than vice versa, then religion must either have some adaptive significance itself or else arise as a by-product out of something else that does. Others have started down this road before including Pinker (1997) and Boyer (2001). Their efforts are to some extent carried on the platform of evolutionary psychology (Cosmides and Tooby 1992) and have met with varied success, but they are raising many important questions along the way (Dennett 2006). For instance, Sloan Wilson (2002) has adopted an interesting group selection approach, but one which has found few supporters. Alternately, religion can be seen as a particularly successful *meme*: Dawkins' term for a self-promoting unit of cultural inheritance and one that is not very popular with some theologians (see McGrath 2004).

Richard Dawkins is particularly scornful of those such as Stephen J. Gould who would take the middle ground (Gould 1999). These scholars are 'live and let live' persons who maintain that scientific knowledge and religious faith are compatible. Gould (1999) calls science and religion *non-overlapping magisteria*. In other words they are intellectual disciplines that do, or should, deal with fundamentally distinct questions. Historical experience teaches that this is far from the case with respect to evolution and cosmology. Further, Gould seems to have failed to heed his own advice to distinguish between empirical observation (prayer works or it does not) and causal explanation (God answers them or does not). The former is always open to systematic investigation, although this is harder to do properly, with respect to the efficacy or otherwise of prayer, than one might think (Stenger 2007). The latter is not strictly open to test, but there does come a point when repeated falsification of such hypotheses has made it perverse to retain belief in the supernatural.

Sam Harris: *The End of Faith*

Here we find the antitheist agenda writ large. Harris' subtitle cries out *Religion, Terror and the Future of Reason.* He is the true herald of The New Enlightenment. His account begins with what in his view constitute the manifold contradictions, viciousness, and absurdities of Judaism, Christianity, and Islam. Next, comes a particularly forceful demonstration that one needs to suspend one's normally reliable critical faculties to buy into supernatural explanations and hence religious beliefs. Religion is rejected as a source of moral authority. Moral and ethical systems based on religious precepts are viewed as necessarily inferior, since they are encumbered by the trappings of their belief systems. This is not to say that being an atheist automatically qualifies one for sainthood either. There are plenty of powerful atheists, past and present, with poor track records in the human rights arena. Stephen Pinker has recently elaborated on a biological explanation for our moral instincts (Pinker 2008).

The next concept to be demolished is that of *Cartesian Dualism* (named after René Descartes (1960) and from his *Discourse and Method and Meditations*). This is a bit like shooting fish in a barrel because, judging from my own admittedly limited experience, mainstream Christian theologians have long since abandoned it. Nonetheless, it is important that Harris takes time to do this because the concept has proved remarkably persistent in the public imagination. In brief, a Cartesian Dualist holds that human beings are bipartite creatures consisting of a mortal body and an immortal soul or spirit. This compelling belief derives from the illusion of self arising from the emergent epiphenomenon known as the human mind (Pinker 1997). Under this strictly biological view, the mind and personality reside exclusively in the brain. They simply reflect the density and distribution of interconnections between neurons coupled with the willingness or otherwise of these central nervous system (CNS) cells to communicate with one another via chemical signals called neurotransmitters. Since our nerve cells are in a constant state of change, we are not even the same person from one day to the next, strictly speaking. All this chemical and electrical activity creates a consciousness that feels as if one's mind was actually separate from the body. It is but a small step before one starts to imagine that the mind and personality live on after the body has passed away. The point that Harris and Pinker are making

is that the mind necessarily dies with the body, since it is physically inseparable from the brain. It is pretty basic biology really, but it is hard for some, perhaps even for many, people to accept because the illusion created is so strong. Dropping the idea of a soul has its consequences. For instance, the ancient concepts of Heaven and Hell become redundant, at least as alternate venues for the ultimate residence of our personalities. In turn, this also gives a entirely new perspective on the 'meaning or purpose of life', i.e. there is none. So maybe we had all best get over it and get on with it? Remarkably, Harris progresses well beyond his simple denial of dualism to discard even singularity eventually and advances a form of the *transcendence* view of 'feeling at one with everything in the Cosmos'. Again, many would see this too as a resort to a spiritual perception.

Harris asks many important questions about religion and morality and more particularly: Why are religious leaders (who are predominantly old men) so concerned with the reproductive affairs of young women? Pinker (1997) has elaborated effectively on this theme from an evolutionary perspective. Harris also asks: Why are issues of religion taboo? and Why do the religious react so poorly to criticism of their beliefs? This theme of hostility is taken up again at the outset of Harris' second book (Harris 2004) which was written in response to correspondence received after publication of his first bestseller reviewed here. Harris expresses his amazement that those Americans who love Jesus Christ can be *deeply, even murderously, intolerant of criticism* from unbelievers.

Daniel Dennett: *Breaking the Spell*

This is a philosopher's extension of the basic science/religion interface theme examined by the others. It has developed in part from his earlier work *Darwin's Dangerous Idea* (Dennett 1995). Two of his key observations appear in this first book: that the historical diversity of life on Earth challenges religious accounts; and that natural selection challenges widely held religious concepts, those of *purposefulness* and *design*. The later volume proceeds to ask the deceptively simple question: Why can't science investigate religion as a social phenomenon and its claims as empirical observations coupled to supernatural explanations? In this context it might be seen as just a backlash against creation science and intelligent design, etc. However, in my view this would be to underestimate its true significance.

Dennett (2006) takes on a major societal taboo: namely the imperative that leads most people to feel that they must show *respect* to all religions and all their works. He holds that it would certainly be prudent to show restraint and develops his theme carefully, but effectively. Like Sagan, he lacks the strident and in my view almost hysterical edge that enters the writing of Dawkins, Harris, and Hitchens at times. Treading lightly is necessary due to the relationship that exists between the religious and their various religions. Dennett likens this to a romantic love affair. This is not unreasonable, and a degree of ecstasy is certainly involved – watching five minutes of your favourite televangelist broadcast should be sufficient to convince anyone. Those who have the trepidation to interpose themselves in this relationship can be sure of a sharp response, as Harris's experiences and correspondence certainly testify.

This author shows real courage in laying out a programme for the scientific investigation of religion. The programme itself is not especially critical of religion *per se*. It just opens every aspect to systematic examination and reviews progress to date in some areas. Overall, Dennett tends to favour a meme-centred viewpoint for the development of religions in a cultural framework v. a genetic type explanation as advanced by Hamer (2004), Alper (2006), and others.

Evaluating the contributions

In these books the argument about who owns the intellectual property seems to be well and truly over. Man invented God and not the other way around. Dualism has been banished, replaced by Pinker's (1997) model of the mind. The final position is not far removed from that of some modern theologians, but even their deist stance, with special reverence for Goldilocks, the Laws of Physics, and general good fortune, is now open to critical scrutiny. Dennett (2006) has placed the means to investigate how it all came about squarely in front of intellectuals and the public. Scientists and philosophers can now choose to pick it up or not as they prefer. A strong lead has already been taken by Boyer (2001), Dawkins (2006), Pinker (1997), and Sloan Wilson (2002).

This impressive body of scholarship has already captured the public imagination. All four major titles have been on the *New York Times* Bestsellers List. They seem to give a real voice to the secret thoughts of a multitude of otherwise lonely and disenfranchised American atheists. The backlash has already started in the form of aggressive apologists like McGrath &McGrath's (2007) *The Dawkins Delusion?* and Day's (2008) *The Irrational Atheist*. By my own estimation a large part of their attack is just rhetoric and innuendo, ironically the very charges that they direct principally against Dawkins and Harris. Nonetheless, their books do contain valuable information and insights, e.g. that conflict is often fuelled by the adoption of religious affiliation as labels for in-group and out-group membership. They also point to the necessity of finding evolutionary explanations for non-theistic religions. For instance, I follow the fortunes of Manchester United Football Club in the English Premier League and European competitions; nobody who comes from round our way thinks that being a Reds fan is anything other than a sincere expression of religious devotion. These and other authors (e.g. Marshall 2007; Robertson 2007) often claim that Dawkins is highly selective in his use of biblical material and quotations from religious persons. They also think he is a pretty poor historian, too. I have no way to judge such claims other than to say that Dawkins, Harris, and Hitchens are mutually consistent. So, if only half of what they say has foundation in fact, then they merit a more well-considered response.

A whole host of 'middle-grounders' has also sprung up following Gould (1999) and including: Ayala (2007), Collins (2006), Dowd (2007), Haught (2008), and Roughgarden (2006) – see Barash (2007) for commentary. All four major sources reviewed here reject the attempt at finding this middle ground because it requires suspension of one's normal critical faculties for over half of one's intellectual life. They feel that it is essential to apply a consistent set of evidential rules and explanations across all experiences. Otherwise one must constantly be suspending disbelief, much as one does when attending a live theatre performance or joining in a children's game of make-believe. Harris comes out most strongly against the middle-ground school and even holds that moderates share

responsibility for the actions of religious extremists, because they serve in part to legitimise them.

Dennett's book is consistently balanced and reasonable, but sometimes seems to wobble round the edges of difficult issues, often checking an otherwise hard-hitting commentary. The tone makes a pleasant change from Hitchens, Harris, and Dawkins in that order, also known as the *unholy trinity* (Day 2008), who are often strident and committed advocates for their worldview(s). Harris has a particularly venomous dislike for some of the practices of Islam and what he sees as the excesses of Sharia Law. Hitchens is more catholic in his condemnation of the horrors that accompany religious prejudice and extremes, while Dawkins strikes one as coming from a more personal angle. True he does express the idea that any theistic religion is necessarily a bad idea, but at the same time he seems to be crusading against indignities suffered by his wife during her childhood. Overall, I would assert that these are issues of style, rather than content.

Sagan, and to some extent Harris also, just seems to approach the plain flaky at times. They both have a tendency to wander off towards infinity and the sublime in discussion of personal feelings related to transcendent wonder at nature and the universe. They don't, however, reach the same exotic extremes of experience and description as Hamer (2004) and Alper (2006). In making this observation I am keenly aware that all of these authors refer to this as a spiritual phenomenon, rather than as religion. I will return to this distinction later.

Missed opportunities?

In this section I will focus on four particular areas where the emergent synthesis is to my mind either a bit thin, confused in some way, or altogether lacking.

The cardinal importance of having clear concepts

When considering any topic as important as the science/religion nexus it is essential to have clear ideas about the subject matter. This is necessary to avoid tangential or parallel debate. For instance, in New Zealand it has become conventional (almost universal) to use the term *spiritual* when one really means religious. Hence, we may often find ourselves in the midst of heated discussions about things like *spiritual values* which if taken at face value would seem to be entirely devoid of meaning. Here it is absolutely necessary for purposeful dialogue to distinguish *religion* as presented by these four authors as something akin to a systematic collection of beliefs and practices coupled with a willingness to embrace supernatural causality v. the idea of *transcendence* or the feeling of being at one with life, the universe and everything. To them, the former has a social foundation in cultural evolution as explained by memes and kin selection as advanced in the works under consideration. In contrast, the latter is inherent to some degree, enhanced by drugs, meditation, and breathing exercises (Hamer 2004; Alper 2006). Its roots seem to arise in gene expression in the central nervous system with ecstatic feelings mediated via metabolism of neurotransmitters, principally dopamine. Where does this leave the term *spirituality*? This seems to be a hang over from Cartesian Dualism and is now best forgotten about altogether.

The intimate link between religion and temporal power

At best the collected works acknowledge this link with a nod in the vague general direction. Nonetheless, this point is of considerable significance. Why, for instance, were Julius Caesar and other Roman Emperors worshipped as living gods? Interestingly, one of the very best accounts may still be found in the pages of Sir James G. Frazer's *The Golden Bough* (see Frazer 1981). In many ways this could be said to represent the first attempt to find evolutionary psychological explanations for the growth and development of religions. All four of the authors whose books are reviewed above refer to this earlier compendium. It is perhaps unfortunate that unfounded assertions are often made to the effect that Frazer's work is flawed in some way and almost unreadable. This is not to say that it is without faults. Boyer (2001) called it an *interminable journey* and a *sterile compilation* because *Catalogues are not explanations*. His observation may be valid in a general sense, but hardly does justice to the work. Indeed, for the careful and particularly devoted reader there is an explicit emergent message (see Box 2) linking celebrity to regal power, dynastic rule, ritual, worship and supernatural events. This area of the science/religion programme is fundamental to the full understanding of how human societies function and is rich in content. It is thus perhaps surprising to find this aspect somewhat neglected by these four authors.

Why religion is hostile to criticism

Together the four authors comment effectively and at length on this universal reaction. However, each reaches a different position. Sagan, it appears, is simply too polite to comment much. For Dawkins religion is just a bad idea with a strong instinct for self-preservation. Harris just seems plain bemused by the intensity of it all. Dennett does offer a causal explanation – the love story model. None of this seems quite adequate. One can well understand religious authorities being jealous of challenges to their own brand of temporal power and influence, but what about the laity? Here again a simple explanation seems to have gone unexplored. A challenge to one's belief system is a challenge to one's rationality. So if communal mental gymnastics are required to support virgin birth, ascent into heaven on a winged horse, etc., as the four authors all suggest, then those who will not suspend their disbelief and perform the required intellectual summersaults may expect a chilly reception. In short, it is simply easier to fight unbelievers than to argue with them. It is well known that people value their individual reputation as rational entities. Thus, the quickest route to a bloody nose is to be found by challenging something that someone else holds dear, but may not have thought about too deeply.

The source of moral values and behaviour

The Four Horsemen are unanimous in their view that moral authority does not stem from God. The alternative position is well developed by Pinker (2008) and even includes an implicit genetic component. The converse (see earlier) is that indirect systems of moral values based on religious teaching are necessarily second-rate products. This is not to say that they are entirely without value. Dawkins may perhaps express the most extreme position on this topic when he asks why TV interviewers on the BBC always drag in some prominent religious figure when debating stem cells, new contraceptives, etc. He argues that views from church leaders like, say, the Archbishop of Canterbury, are at best irrelevant and at worst an error-prone distraction. I do not think that this is a fair assessment. Church-based groups have often thought about the issues in depth and already discussed them at length. So religions may yet turn out to be things of comfort, charity, and moral guidance, even if they were created exclusively by directed human energy, rather

Box 2: A Neo-Frazerian model of popularity, power, and religion

The line of development presented here is a précis of the emergent explanation contained in Professor Sir James Frazer's epic, but near-indigestible, work, *The Golden Bough.* This is a global survey of the origins and practices of magic, religion and folklore.

1. Only our best and fairest do we make into Kings.
2. We love our monarchs dearly and bestow great wealth upon them and grant them power over us.
3. The friends and relatives of Kings are treated as special people, too (nobility), and a well-established reign tends to become dynastic.
4. Our rulers must appear before us and become beset with rituals – even if this does serve to make their lives a living hell and steals their power.
5. Our Royals should have leading religious roles and evolve to become living gods credited with miraculous powers.
6. As gods cannot die, but Kings inconveniently do seem to do so, then we must all agree that they will be resurrected after death. This process can be assisted by a splendid burial involving public ceremonies and great expense.

If readers wish to test the utility of this conceptual framework, I suggest that they try applying it to Elvis Presley or the British Royal Family or Arnold Schwarzenegger. Everyone who becomes famous fits in somewhere.

than being divinely inspired; see Boyer (2001) for a list their potential assets. In short, we may be looking at a baby-and-bathwater situation, despite Dawkins' desire to dump the lot down the sink.

Closing comments

There is no doubt in my mind that these works are not just a passing swipe at 'intelligent designers' and creation science people. They are more, much more. The floodgates have opened, and new books on science and religion are now pouring forth, faster than anyone can reasonably be expected to read them. The four titles here are key, but not exclusive, elements in New Enlightenment thinking. This is characterised by a fresh worldview perspective that asks not the one religious question: 'How did God create man?' but the two secular scientific questions: 'How did man invent God?' and 'Was it such a good idea in the first place?' The programme, as laid out in part by Dennett (2006), is off to a good start, and significant contributions (reviewed above) have already been made. In their collective view, the orthodox religious position was long ago ceded by progressive theologians and the middle ground has become untenable or at least uncomfortable. Whatever the dangers of violent fundamentalist response, the way is now open to investigation of evolutionary explanations for religions and all their facets. A new rational standard for belief has been established. The Four Horsemen explore at length the paired concepts of *belief* and *faith* together with their manifold meanings. This topic is something I have not covered in this article since it lies some way beyond the science focus.

The emergent intellectual infrastructure is still not completely satisfying, as I have explored in the immediately preceding section of this article. For instance, we must strive harder to develop clear concepts if one is ever to distinguish between the status of nature and nurture in the debate. Religion is a human behaviour and all human behaviours have a greater or lesser genetic component. What genes are involved and what are their roles? How can we distinguish what is important from what is not? Many loci are likely to be involved, but lots of them will have incidental roles and their identification is likely to be unedifying. For example, without a mind one can't easily worship a God and to run the CNS one must have functional genes encoding all the enzymes and proteins that are required to build it and keep it operating well. But these components alone don't make one religious or otherwise—they are necessary but not sufficient.

The Four Horsemen head an army of followers who are now unafraid for their views to come out. They are leading an invasion of hallowed ground, which will surely not be relinquished without a prolonged struggle. However, their ultimate success seems certain as others flock to join the ranks of these strictly rational thinkers. The New Enlightenment provides a home for ideas whose common time has come at last.

References

Review titles

Dawkins, R. 2006. *The God Delusion*. Houghton Mifflin Co., Boston.

Dennett, D.C. 2006. *Breaking the Spell: Religion as a natural phenomenon.* Penguin Press, New York.

Harris, S. 2004. *The End of Faith: Religion, terror and the future of reason.* W.W. Norton & Co., New York.

Sagan, C. 2006. *The Varieties of Scientific Experience.* Penguin Press, New York.

Principal references

Alper, M. 2006. *The God Part of the Brain: A scientific interpretation of human spirituality and God.* 5th edn. Sourcebooks Inc., Naperville.

Barash, D.P. 2007. The DNA of religious faith. *The Chronicle of Higher Education 53*: B6.

Baggini, J. 2003. *Atheism: A short introduction.* Oxford University Press, Oxford.

Hamer, D. 2004. *The God Gene: How faith is hardwired into our genes.* Anchor Books, New York.

Harris, S 2007. *Letter to a Christian Nation.* Alfred A. Knopf, New York.
Hitchens, C. 2007. *God is not Great: How religion poisons everything.* Twelve, New York.
Marshall, D. 2007. *The Truth Behind the New Atheism: Responding to the emerging challenge to God and Christianity.* Harvest House Publishers, Eugene, Oregon.
Pinker, S. 1997. *How the Mind Works.* Allen Lane, London.
Pinker, S. 2008. The moral instinct. *New York Times*, 13 Jan. 2008.
Robertson, D. 2007. *The Dawkins Letters: Challenging atheist myths.* Christian Focus, Frean, Dunfrieshire.
Stenger, V. J. 2007. *God the Failed Hypothesis: How science shows that God does not exist.* Prometheus Books, Amherst.
Tallon, J. 2007. 'The scientific origins of God' – a response. *New Zealand Science Review 64*: 47–51.

Other sources

Ayala, F.J. 2007. *Darwin's Gift to Science and Religion.* Joseph Henry Press, Washington DC.
Barrow, J.; Tipler, F. 1988. *The Anthropic Cosmological Principle*. Oxford Paperbacks, Oxford.
Boyer, P. 2001. *Religion Explained: The evolutionary origins of belief.* Basic Books, New York.
Collins, F.S. 2006. *The Language of God: A Scientist presents evidence for belief.* Basic, New York.
Cosmides, L.; Tooby, J. 1992. *The Adapted Mind: Evolutionary Psychology and the Generation of Culture.* Oxford University Press, New York.
Davies, P.W. 2006. *The Goldilocks Enigma.* Allen Lane, London.
Day, V. 2008. *The Irrational Atheist: Dissecting the unholy trinity of Dawkins, Harris and Hitchens.* BenBella Books, Dallas, Texas.
Dowd, M. 2007. *Thank God for Evolution.* Council Oak Books, San Francisco.
Dennett, D.C. 1995. *Darwin's Dangerous Idea: Evolution and the meanings of life.* Simon and Schuster, New York.
Descartes, R. 1960. *Discourse and Method and Meditations.* Transl. by L.J. Lafleur for Library of Liberal Arts, Indianapolis, Indiana.
Frazer, J.G. 1981. *The Golden Bough: The roots of religion and folklore.* Avenal Books, New York – illustrated reprinting of the 1890 original work.
Gould, S.J. 1999. *Rocks of Ages: Science and religion in the fullness of life.* Ballantyne, New York.
Haught, J.F. 2008. *God after Darwin: A theology of evolution.* 2nd edn. Westview Press, Philadelphia, Pennsylvania.
James, W. 1971. *The Varieties of Religious Experience.* Fontana Press, London.
McGrath, A.E. 2004. *Dawkins' God: Genes, memes and the meaning of life.* Blackwell, Malden, Massachusetts.
McGrath, A.E.; McGrath, J.C. 2007. *The Dawkins Delusion: Atheist fundamentalism and the denial of the divine.* InterVarsity Press, Downers Grove, Illinois.
Roughgarden, J. 2006. *Evolution and Christian Faith: Reflections of an evolutionary biologist.* Island Press, Washington DC.
Sloan Wilson, D. 2002. *Darwin's Cathedral: Evolution, religion and the nature of society.* University of Chicago Press, Chicago.

News

Who you gonna call? Communicating science in New Zealand

Jean S Fleming
Centre for Science Communication, University of Otago, PO Box 56, Dunedin

This Easter, my partner and I walked the Milford Track. Grant made the journey for the first time, whereas I had previously walked the track with my family as a child. Each night I looked up the log books from 45 years before and found my carefully written signature and comments. This was a strange sensation, which made me realise what a wealth of experience and delight my life has brought to me so far. The group we walked with included New Zealanders and Australians, but also a number of British and North American visitors, all keen to discover the delights of wild New Zealand. Although the local knowledge of our excellent guides was considerable, there were times (when we came upon a pair of blue duck feeding in the Clinton River, for example), when the guides were elsewhere. To our surprise, we found we could answer most of the questions put to us about the birds, plants and geology around us. Thinking about this later, I realised the benefits of the broad scientific education I had received from my family as well as from more official institutions.

Growing up in a family passionate about science and the New Zealand environment has also left me with a strong love of my country and its flora and fauna. It is therefore fitting perhaps, for me to return after three years in southeast Queensland, to help establish New Zealand's first Centre for Science Communication, at the University of Otago in Dunedin. The big issues of today's world demand some understanding of science and the scientific process, so that we can make personal decisions on our lives and on the future of the country, whether we are thinking of global climate change, peak oil, stem cell therapies, or human cloning. We already have the technologies and know-how available to deal with many of the issues we face, but how do we make the science available to a general population, who can clearly see, for example, the dilemma of producing biofuels at the expense of food production, but don't know about the possibility of biofuels from algae feeding on sewage-sludge? In a world where fewer are choosing to study science at tertiary level, accessible information is vital, so we can interpret the messages we see on the television or internet. I envisage the Centre becoming a user-friendly resource where people can access information and in particular evidence, to help them understand and make decisions on the scientific issues of the day. By offering training in communication skills, the Centre for Science Communication will also produce a new generation of young scientists, more capable of getting their message across to young and old.

The Centre for Science Communication

The Director of the Centre is Professor Lloyd Spencer Davis, who holds the inaugural Stuart Chair in Science Communication at the University of Otago. We offer a two-year Masters in Science Communication in three flavours: Science and Natural History Film-making, Creative Non-fiction Writing in Science, and Popularising Science, which includes on-line, exhibition and performance science communication. In 2008 we have 30 Masters students at the start of their two-year course and a further two in the second year. In addition the Centre runs a one-semester course in Communicating Science, open to all Bachelor graduates, whether in science, commerce, or the humanities.

The Centre was launched on 21 February 2008, with an inaugural Distinguished Communicator's lecture from one of New Zealand's best known science communicators, Professor Paul Callaghan (The McDiarmid Centre, Victoria University) on 'Science as Leadership: a Challenge for the 21st Century'. At the same time, Graeme Wilson, Chairman of the New Zealand Screen Council, launched 'The Business of Documentary Filmmaking', a book by Claudia Babirat (the first graduate of the new Master of Science Communication, MSciComm) and her supervisor, Lloyd Spencer Davis. The Centre builds on the internationally recognised Diploma of Natural History Film Making run at Otago since 2001, in association with Natural History New Zealand (NHNZ), the world's second-largest producer of factual films. We will initially provide training for postgraduate students in science communication techniques.

The Director of Film-making is Ian McGee, who has a long history with both the Zoology Department at Otago and with

Jean Fleming ONZM is Professor of Science Communication at the Centre for Science Communication, University of Otago and holds a joint research appointment at the Department of Anatomy and Structural Sciences, Otago's School of Medical Sciences.

Professor Fleming may be contacted at jean.fleming@otago.ac.nz

NHNZ. Ian won an Emmy Award for Outstanding Achievement in a Craft in News and Documentary Programming – Writers, for his film *Twisted Tales: The Bat*. He has subsequently had a further two Emmy nominations for later documentaries. Lloyd Davis leads the Creative Non-fiction Writing course and I convene the course in Popularising Science. Masters students spend their first year completing course work and planning for the production of their thesis and film, book, or exhibit. Central to all Masters courses is a paper on the craft of storytelling, but students can also complete internships in film-making or learn about digital design for factual communication. The inaugural course on Communicating Science for Bachelors graduates has thirteen students in 2008, five of whom are completing a full Masters in Popularising Science. We consider this course, which has workshops on interview techniques, writing and visualising science, science and society, video techniques, exhibitions, infographics, online communication, and media releases, will expand rapidly in the future. Our emphasis is on the production of useful outputs, feeding back into Otago science and community. Staff from the departments of Zoology, Botany, Design Studies, Philosophy, Marine Sciences, Media Film and Communication Studies, as well as from the Otago Museum, teach in the Science Communication courses.

The Centre for Science Communication is currently run from the Zoology Department in Otago's Division of Sciences and is physically located in its own building opposite the Zoology Department. We are rapidly building networks within the University of Otago and also with a diverse group of interested organisations, including Otago Museum, the Dunedin International Science Festival, the National Energy Research Institute, The New Zealand Marine Studies Centre at Portobello, the Biodiversity Project, Orokonui Ecosanctuary, and the National Centre for Lifecourse Research.

Looking to the future

The Centre for Science Communication aims to produce graduates skilled in taking science to the world. The Masters theses of these graduates will provide a rich library of resources, forming a hub linking Otago science to the world. Eventually I would like to see the development of a virtual science communication centre, such as in Second Life (http://secondlife.com/), created largely by MSciComm students, where people from anywhere in the world can sift through the scientific evidence on topical issues of the day, or can be linked to experts or organisations in that field. Otago's Centre for Science Communication must also become a place where people feel free to walk in the door and ask questions. We have already initiated our Distinguished Communicators lecture series and have many interactions with programmes such as Hands-on Science (Otago's secondary school summer science programme), the Otago Museum, the Portobello Marine Studies Centre and Aquarium, and the Dunedin International Science Festival. We realise the potential need for undergraduate courses on professional presentation and communication of science, as well as in the history and philosophy of the scientific method. We are also keen to pursue contacts with business and industry, for example in the biotechnology area, and to develop strong links with Ngai Tahu to encourage more Maori students into science. On a more personal level, I have become a regular guest on Bryan Crump's Nights on Radio New Zealand National, discussing Body Parts at a suitably post-prandial time on a Thursday night.

The Centre for Science Communication has many challenges ahead, as our country—indeed our planet—faces a future of climate change, scarce resources, and increasing population. My walk in the wilds of Fiordland this Easter has shown me the potential and importance of sustainable development for New Zealand and New Zealanders. Without the infrastructure of the tracks and lodges there would be no paying walkers. Without the visitors there would be less money for trapping stoats, deer and possums, not to mention the baths of detergent we walked through, to try to control the spread of didymo into these beautiful valleys. With the removal of pests, the plants and birds appear to be thriving once again. The important message here is one of hope for the future. Yes there will be challenges to face, but the Centre of Science Communication will be part of future solutions, providing practical, evidence-based advice on the steps each individual can take to care for their environment, and creating films, books, exhibits and performances, to get the message across.

So watch this space! Contact the Centre for Science Communication at the University of Otago on www.sciencecommunication.info or email sciencecommunication@otago.ac.nz or jean.fleming@otago.ac.nz for further information. We'd love to hear from you.

Acknowledgement

I would like to acknowledge Rose Harrison, Division of Sciences, University of Otago, for her useful contributions to this article.

New Zealand Association of Scientists Inc
PO Box 1874
Wellington
New Zealand

19 May 2008

Dear NZAS Member

Membership expertise

NZAS is an independent voice for New Zealand Scientists, and the Council of NZAS wishes to raise the profile of the Association through more publicity in the mainstream media and through increased membership.

In 2008 we are in the process of:

- Assisting in the analysis and then publicising the results of an independent survey looking at the opinions of working NZ scientists on career structure, etc.
- Requesting statements from all political parties on their research science and technology policies.
- Writing press releases commenting on topical scientific issues as the opportunity arises. For example: on 18 March 2008 an article appeared in the *NZ Herald* prompted by an NZAS press release. See: http://www.nzherald.co.nz/topic/story.cfm?c_id=221&objectid=10498983

Although Council has a diverse membership, we would like to be able to call upon other members of NZAS for their expert opinions and comments for incorporation into our press releases. If you are agreeable could you please indicate your:

1. scientific expertises
2. willingness to help draft material on topics of interest

by emailing the Secretary (fiona.mcdonald@otago.ac.nz) or contacting the President, Associate Professor Kathryn McGrath, by phone 04 463 5963 or email: Kate.McGrath@vuw.ac.nz

Yours sincerely

Fiona McDonald
for NZAS Council

New Zealand Association of Scientists 66th Annual Report

President's report for 2006/07

It is a great privilege to present the President's Report for the 2006/07 year to the 66th Annual General Meeting of the New Zealand Association of Scientists. Let me start with a few highlights and observations.

Regular publication of *New Zealand Science Review,* and attention to the quality and relevance of its content, continue to be of major importance to your Council. We recognise the significance of this Journal, both to the Association membership and the wider research community, and give priority to the allocation of the resources necessary to support the Editor in the fine job he continues to do for us.

During the year we have faced the challenge of organising the 2007 National Survey of Scientists in conjunction with Professor Jack Sommer of the University of North Carolina at Charlotte. The survey enables a statistically representative sample of research scientists (about 1:10) with relevant qualifications (masters and doctoral degrees) to express their opinions on matters of vital concern to themselves and their professional environment. This project has required a major contribution from your Officers and individual Council members, and we still have much to do.

On an important occasion such as our Annual General Meeting, we should remember that everyone holding office in NZAS is an unpaid volunteer and that there must be limits to what we can demand of them. I am of the opinion that we need to review past practices and be prepared to remunerate those who provide professional services beyond what may reasonably be expected of a volunteer. In this regard I believe that the role of Editor of *New Zealand Science Review* is worthy of special consideration when funds allow.

Before discussing NZAS activities in detail, I wish to change the normal order of business and record my personal thanks and those of the Association to the elected and appointed Officers with whom I have served:

Professor Neil Curtis, our Patron

Hamish Campbell, Past-President

Kate McGrath, Vice-President

Janet Grieve, Treasurer and Membership Secretary

Fiona MacDonald, Executive Secretary

Allen Petrey, Editor of *New Zealand Science Review*

Ken Aldous and David Penny, organisers of the NZAS annual awards.

I also thank Council members with particular responsibilities, as follows:

Ross Moore, Minute Secretary, who also assisted me with Survey coordination and liaison with Prof. Sommer

George Jones, for maintaining e-mail contact with members and organising new medals

Vanessa Sherlock, Website Manager.

Finally, I gratefully acknowledge all other members of Council: Mike Berridge, John Clare, Dennis Gordon, Vince Gray, David Heath, Euan Smith, Chris Sissons, and Mike Staines. Their contributions have been invaluable in ensuring the success of NZAS activities during the year.

Council meetings

Our seven meetings this year were very well attended. Thanks must go to all members of Council for their input to our meetings. Both Janet Grieve and Ross Moore have provided much valuable advice to me on matters of NZAS policy and protocol. Neil Curtis provided very helpful contributions on climate change and prepared a commentary with myself on the 2007 OECD review of New Zealand's innovation policies. Allen Petrey has again done sterling work as Editor of *New Zealand Science Review*. In addition, all members of the Science Review Editorial Committee (Janet Grieve, Hamish Campbell, Mike Berridge, Dennis Gordon, and myself) have devoted considerable amounts of time and energy to reviewing and commenting on articles submitted to us for publication.

The national survey of scientists

Following surveys conducted in 1993, 1996 and 2000, this year NZAS is running a fourth nationwide Survey of Scientists in order to gain insight into their perceptions of, and attitudes towards, their careers and towards New Zealand's wider science environment. An NZAS Survey sub-committee (Ross Moore, Janet Grieve, Kate McGrath, Mike Berridge and myself) ensured that the survey addressed the key issues facing scientists in New Zealand, and that all technical requirements of database development were addressed.

We are very pleased that Professor Jack Sommer, of the University of North Carolina at Charlotte, was able to come to New Zealand to oversee this survey, and our sincere thanks go to Dr Lesley Hunt, of Lincoln University, for her expert assistance. We are especially grateful to the Ministry of Research, Science and Technology and the Royal Society of New Zealand, both for financial support and for valuable input to survey design. Since the inception of these surveys, Owen Watson of the Royal Society has been involved with the IT aspects of the databases used in our surveys, and we are indebted to him for his expertise. The contributions of the people and institutions mentioned here, and many others besides, have enabled us to develop a robust and relevant survey instrument. We are confident that the survey will make a worthwhile contribution to science policy and strategy development and will result in long-term benefits to New Zealand's economy, environment and society.

Discussions on climate change

On assuming the Presidency, I expressed the hope that NZAS could agree on a clear position on climate change. I believe strongly that New Zealand's climate change policy and research communities are of international quality and that their work and conclusions deserve ongoing recognition and support. Council debated climate change vigorously on two occasions but it proved difficult to reach a consensus position in the face of spir-

ited opposition from a minority. Eventually, it was decided not to issue a public statement on climate change until Council could demonstrate that it reflects the considered view of a significant proportion of the NZAS membership. Logistical difficulties, time constraints and questions around the statistical validity of a poll of members, resulted in a decision to take no further action in the meantime. Although personally disappointed to see the matter deferred, I believe that all of us on Council learned a great deal from the discussions.

Working relationships with government agencies

NZAS continues to play its part in fostering enhanced working relationships across the research sector, and this year Council held an important meeting with Dr Roger Ridley and Lesley Middleton of MoRST. We discussed a range of issues, including the need to include our top researchers in the formulation of Government policy, New Zealand's level of public and private RS&T investment, transaction costs and other systemic funding issues. At other Council meetings we met with Dr Yelena Thomas (newly appointed Director of MoRST's Evaluation Unit) and with Geoff Lewis, a Principal Adviser at Treasury interested in RS&T and innovation policy. A frank exchange of views ensued at each meeting, and the key message for us is that both MoRST and Treasury are firmly committed to New Zealand science, irrespective of differences in our perspectives on the major issues.

We all want to see economic development and a sustainable environment, taking due account of the health and wellbeing of New Zealanders. We also want to see increased RS&T investment and improvements to funding mechanisms. In representing New Zealand scientists, NZAS has an obligation to express its sincerely held views freely and effectively and your Council will continue to do so in a constructive manner. It must be admitted that in many aspects of science policy NZAS holds views different from Government's. The key for NZAS will be found in engaging collaboratively with MoRST, Treasury, and other arms of Government, for only through mature dialogue and frank exchange of perspectives will significant progress be made.

New Zealand Science Review

This year we published four issues, including one double issue. Volume 63(3-4) was devoted to New Zealand's fisheries and fisheries research. A wide range of relevant topics was covered in the following articles: *Fisheries and fisheries research in New Zealand* (John McKoy of NIWA); *Orange Roughy. What might the future hold?* (Matthew Dunn, NIWA); *Ageing a fish — how and why?* (Peter Horn, NIWA), *New Zealand applications of new tagging technology to track migratory marine fish and birds* (Don Jellyman, Malcolm Francis and Paul Sagar, NIWA); *Assessing Antarctic toothfish stocks in the southernmost fishery in the world* (Stuart Hanchet and Alistair Dunn, NIWA); *Ocean variability and declining hoki stocks: an hypothesis as yet untested* (Janet Bradford-Grieve, Philip Sutton and Mark Hadfield, NIWA, and Mary Livingston, Ministry of Fisheries). We also published a poem by Stuart Hanchet (*A Lament for a Fishery*), perhaps somewhat tongue in cheek, but embracing a highly important message about the questionable sustainability of our fisheries.

Volume 64(1) includes an article on the National Science Panel, written by the panel Chair, Dr Jim Watson. The article outlines the panel's views on New Zealand science policy and indicates the challenges presently faced by the panel in advocating on behalf of New Zealand science. Peter Winsley of MAF provides an informative discussion on pyrolysis production of biochar and bio-oil. High-carbon biochar can be sequestered in soils, where it reduces nitrous oxide emissions and enhances soil structure. Bioenergy can substitute for fossil fuels and reduce carbon dioxide emissions. Professor John Lekner of Victoria University provides a fascinating insight into the life of Albert Einstein and both his and others' contributions to the early development of quantum mechanics. This issue includes a NZAS discussion document on climate change which stimulated much debate within NZAS Council. Professor Neil Quigley, also of Victoria University, presents an informative account of doctoral studies there. Professor Quigley discusses Victoria's supervision policies and provides examples of research undertaken recently by doctoral students.

Volume 64(2) provides a brief commentary on the 2007 OECD Review of Innovation Policy: New Zealand, written by Emeritus Professor Neil Curtis and myself. ESR's Rob Lake and colleagues from Massey University, the Food Safety Authority, and NIWA discuss quantitative modelling of campylobacteriosis as a way of understanding the ecology and public health significance of this organism in New Zealand. Brent Gilpin (also of ESR) discusses the potential of microbial genotyping in disease investigation. Additionally, Brent introduces us to PulseNet Aotearoa New Zealand, which presently, though to a limited extent, mirrors similar international rapid laboratory approaches to disease determination.

In an article entitled *The Scientific Origins of God: a response*, Professor Jeff Tallon provides a personal response to views expressed previously at a Café Scientifique style presentation by Emeritus Professor Lloyd Geering. Caroline Saunders and Andrew Barber of Lincoln University give an article entitled *Carbon Footprints, life cycle analysis, food miles global trade trends and market issues*. This article discusses research undertaken at Lincoln's Agribusiness and Economics Research Unit to support New Zealand's response on 'food miles', an issue of great concern today.

Membership

Once again, net membership has dropped slightly over the past year. Declining membership is for us an issue of continued concern. Subscription rates were unchanged for this year and overall income has remained reasonably stable compared with previous years. Council is exploring ways and means of increasing our membership but we should not forget the part individual members can play by encouraging their professional colleagues to join us.

Awards and medals*

The Marsden Medal, Shorland Medal and Communicators Award were presented at the Annual General Meeting.

For the fourth year in succession, Council agreed that NZAS would participate in a collective awards ceremony for New Zealand science societies and organisations, planned and run by the

* This part of the President's report is abridged, as details of the Association's awards and medals are given in the following article. ***Editor***

Royal Society of New Zealand (RSNZ). As we were restricted to one presentation this year, we selected the NZAS Research Medal for award at this event in order to publicise the achievements of our younger scientists before a wider audience.

The 2007 RSNZ Science Honours Dinner was held in Dunedin on 20 November. This was a splendid event, attended by honoured guests from New Zealand's research community. Hamish Campbell (Past-President) presented the Research Medal to Associate Professor Kathryn (Kate) McGrath on behalf of NZAS.

The Marsden Medal is awarded to recognise scientists who have made an outstanding contribution to the cause or profession of science in New Zealand. The recipient of this medal for 2007 is Professor Ailsa Golding of the University of Otago. Ailsa has published a large volume of research on nutrition and children's health, and has been supported through the Health Research Council.

The Shorland Medal is awarded in recognition of a personal lifetime of research that has resulted in advances in knowledge or significant benefits to society. The 2007 medal is presented to Dr Robin Mitchell of HortResearch. Dr Mitchell is an organic chemist who has worked extensively on natural products.

The Research Medal is awarded to a young scientist for outstanding fundamental or applied research in the physical, natural or social sciences published during the preceding three years. The winner of the 2007 medal is Associate Professor Kathryn McGrath of Victoria University of Wellington. Professor McGrath specialises in physical chemistry and soft matter physics.

The Science Communicator Award is presented to practising scientists for excellence in communicating to the general public in any area of science or technology. The 2007 winner is Dr Simon Pollard of the University of Canterbury and the Canterbury Museum. Dr Pollard researches the biology of spiders, and has been active in promoting science as a natural history writer and photographer.

David Lillis
President, NZAS
18 November 2007

New Zealand Association of Scientists 2007 Awards

Ken Aldous
Christchurch

The Association's Research Medal was presented at the 2007 Science Honours Dinner, held in the Dunedin Town Hall on the 20th November. The Royal Society of New Zealand organised and hosted this annual event, at which achievements across the whole of the New Zealand science community are celebrated.

The Marsden and Shorland Medals, and the Communicator Award were presented at the Association's 2007 Annual General Meeting, on 22nd November, at Science House in Wellington.

Marsden Medal

The New Zealand Association of Scientists' Marsden Medal is awarded to recognise people who have made an outstanding contribution to the cause or profession of science in New Zealand. The recipient of the medal for 2007 was Professor Ailsa Goulding, Professorial Research Fellow at the University of Otago Department of Medical and Surgical Sciences, for her sustained leadership and personal contribution to research on bone density, osteoporosis, and the role of obesity and nutrition in children's health.

Professor Goulding's work is widely recognised and has resulted in national and international collaborations and consultation on public nutritional and health issues. She also regularly supervises students in postgraduate studies and has incorporated a steady steam of enthusiastic young investigators into her team.

Professor Goulding and her group were the first to publish data that showed that children with forearm fractures had low bone density. She then showed that obese children do not have adequate bone structure to support their increased weight and that they are at increased risk of fractures.

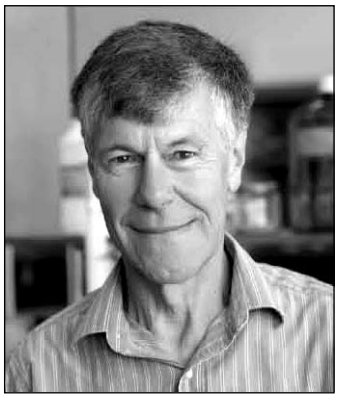
Professor Goulding's group has also demonstrated the deleterious effect of avoidance of milk during childhood. This avoidance is associated with poor skeletal development and obesity. Another dietary factor that they have shown to be important in bone loss is high salt intake which leads to urinary loss of calcium.

All of this ground-breaking work was built on a solid foundation of earlier results from animals to show the effects of corticosteroids, oestrogen, and salt intake on bone.

Professor Goulding's demonstration of linkages between nutrition, obesity, bone development, and childhood fractures has generated considerable media interest at national and international levels. Her work has done a lot to promote the role of science in addressing practical health issues.

Shorland Medal

The New Zealand Association of Scientists' Shorland Medal is awarded in recognition of a lifetime of research that has resulted in advances in knowledge or significant benefits to society. The 2007 medal was awarded to Dr Robin Mitchell, of HortResearch, Mt Albert, for making an outstanding personal lifetime contribution in using the skills of a chemist to answer an important biological and commercial problem - how pathogenic bacteria cause harm to plants.



Dr Mitchell has a national and international reputation for his work of more than 35 years on the toxins of plant pathogens. He is recognised internationally as a pioneer in the field of phytopathogen toxin research. He has discovered four different compounds or compound families that are active toxins and is working on a fifth novel toxin family.

The isolation and characterisation of these toxic compounds required him to develop new methods for separating out several unstable compounds present in solutions at extremely low concentrations. He had to determine which fraction was associated with which biological activity, and to purify extremely small amounts so that the chemical structure could be established. It took four years to isolate the toxin produced by bacterial halo blight of beans. This work won him the Easterfield Medal of the New Zealand Institute of Chemistry in recognition of the quality and originality of his research work.

His work not only reveals the structure of the toxins but also determines the pathways of toxin synthesis and the interrelationships between the toxins and the host plant. More recently he has developed an interest in the possible use of naturally produced bacterial toxins as a means of controlling fireblight in apples.

This work is inherently difficult and his success shows what long-term, sustained, meticulous research effort combined with imagination, determination, and foresight can achieve.

Research Medal

The New Zealand Association of Scientists' Research Medal is awarded to a young scientist for outstanding fundamental or applied research in the physical, natural, or social sciences. The winner of the 2007 medal was Associate Professor Kathryn McGrath of the MacDiarmid Institute, at the Victoria University of Wellington School of Chemical and Physical Sciences, for her outstanding research over the last three years that spans the disciplines of physical chemistry and soft-matter physics.

In nature and in man-made materials there are distinct two- and three-dimensional patterns of organisation in systems

that are classically fluid or solid, or have characteristics pertaining to both. For many of these natural and man-made materials, the pattern of interaction among components of the system is controlled by the weak forces of interaction between the molecules, leading to assembly of components into higher-level structures. Investigation of this process of self-assembly has driven Professor McGrath's research interests.

She and her team are focused on applying knowledge of the self-assembly process to see how it can be used to control patterning and thereby the macro-scopic physicochemical properties of fluid and solid materials. To this end, the work of her group is focused on three main classes of materials:

1. Energetically stable liquid-crystalline systems, which span the range of roughly 1–100 nm. Here, the liquid-crystalline state is achieved through changes of temperature or via the addition of an appropriate solvent such as water. Examples of such systems in everyday use are LCD TVs, in which the self-assembly is manipulated by applied electrical fields.
2. Kinetically stabilised emulsion colloidal systems. Characteristic length scales in emulsions (e.g. milk) range from 100 nm to 100 μm. Emulsions are also used as model systems for biological processes and are widely used in drug delivery.
3. The other class—biominerals—fits the solid-materials group. Biominerals are the hard tissues synthesised by organisms in egg shells, bones, and the like. The biomineral of interest in Kathryn's group is calcium carbonate, which is the base material used by many organisms. In humans, for example, μm-sized calcium carbonate crystals within our inner ear are used to orientate ourselves in gravitational fields. Using sea urchins as a model organism, Kathryn's group is studying formation of calcium carbonate in the shell, looking at the interaction of molecular forces involved in precipitation, and 'soft templation'—the inducement of crystal formation by a surface such as a cell membrane.

In addition to the research excellence of Kathryn and her team, she is considered to be one of New Zealand's leading young physical scientists and has natural leadership qualities. She plays an active role in the life of the MacDiarmid Institute and is or has been the supervisor of six doctoral and three masters students and co-supervisor of a further eight doctoral students.

Communicator Award

The Association's Science Communicator Award is presented to practising scientists for excellence in communicating to the general public in any area of science or technology. The 2007 winner was Dr Simon Pollard of the Canterbury Museum.

Dr Pollard is curator of invertebrate zoology at the Museum, and an adjunct associate professor in the School of Biological Sciences at the University of Canterbury.

Simon has contributed widely to the public understanding of science through talks to community groups, including Probus Clubs, U3A, WEA, schools, Christchurch Polytechnic, Continuing Education programmes at the University of Canterbury and outreach programmes at schools, and as a regular contributor to the 'Ask a Scientist' column syndicated to New Zealand newspapers. His research on blood-drinking spiders in Kenya has featured widely in these addresses.

He has written for a number of natural history magazines around the world, including a regular column in *Nature Australia* (now unfortunately folded), where he wrote about recent research on animals ranging from naked mole rats to coelacanths and anteaters.

Simon has provided advice for natural history documentaries. His research on a crab spider from Borneo featured in the BBC series *Planet Earth*. This work led to his unravelling of extraordinary details about the spider's life, which featured in his recent talks to various organisations and outreach programmes for schools, and featured in an article in the science section of *The Christchurch Press*.

He has been an invited speaker in the USA and Singapore; and in 2006, following a phone interview for the *Los Angeles Weekly Magazine,* he gave a public talk in the USA entitled 'What is it like to be a spider?.

Simon is also a natural history photographer whose images have appeared in *National Geographic*, *Time*, and *Natural History,* and at exhibitions at the National Museum of Natural History in Washington DC and the American Museum of Natural History in New York. In New Zealand he has organised photographic exhibitions on natural history at Canterbury Museum and the Centre for Contemporary Art in Christchurch.

Simon has also written children's books on spiders and insects. His book, *I am a spider,* won the LIANZA [Library & Information Association of New Zealand Aotearoa] Elsie Locke Award for non-fiction book of the year and his co-authored, *Biggest, littlest spiders,* won the Mocking Bird Book of the Year Award in the USA. He has been invited to the Storylines Book Festival in Auckland a number of times and, with other writers and illustrators, travelled around schools to talk about natural history.

Simon is often interviewed on television and radio as a spider expert and natural historian. He has been interviewed twice by Kim Hill in the space of a few months, the first of which was repeated on New Year's Day as one of her favourite interviews of the year.

Patron and Council for 2007/08

Patron

Emeritus Professor Neil F. Curtis completed his BSc, MSc(Hons) and PhD at Auckland University College, University of New Zealand. After two years of postdoctoral work with Sir Ronald Nyholm at University College, London, he returned to New Zealand in 1957 as lecturer in Chemistry at Victoria University before eventually being promoted to a Personal Chair in Chemistry. Neil was Chairman of the Department of Chemistry from 1984 to 1987. He retired in 1996, but continues his research in coordination chemistry, largely with azamacrocyclic ligands, as Emeritus Professor at Victoria University.

Neil is a long-time member (Fellow) of the New Zealand Institute of Chemistry, and has served variously as Branch Committee Member and Chairman. He was awarded a Fellowship of the Royal Society of New Zealand in 1975 and served variously as Councillor, Hon. Treasurer, Vice-President of the Society and Chairman of the Interim Council during the 1990's restructuring. He was awarded the Marsden Medal by the New Zealand Association of Scientists in 1994, and has since been Patron of the Association.

President

Associate Professor Kathryn McGrath has a BSc (Hons) degree in Chemistry (Canterbury University) and a PhD from The Australian National University (Department of Applied Mathematics), Canberra. After completing her PhD Kate took up a post-doctoral position at L'Université de Pierre et Marie Curie – Paris VI (Laboratoire de Mineralogie et Cristallographie), in Paris, working with Maurice Kléman. Her second post-doc was in the Physics Department at Princeton University, Princeton, with Sol Gruner. This was followed by her joining the Department of Chemistry, University of Otago, as a lecturer. Kate stayed at Otago for six years, completing a PGDip Com in Finance in her spare time.

In January 2004 she moved to Victoria University of Wellington. Kate is also a Principal Investigator in the MacDiarmid Institute and an Associate Investigator in the Riddet Institute, both Centres of Research Excellence.

Kate has been heavily involved in administrative duties and leadership roles both within her School, the wider University and the MacDiarmid Institute, organising for example AMN-3 (The Third International Conference on Advanced Materials and Nanotechnology), held in February 2007. In addition to being President of the NZAS, she is Secretary of the Wellington Branch of the New Zealand Institute of Chemistry (NZIC). She has received the Easterfield Medal, awarded jointly by the NZIC and Royal Society of Chemistry (2003) and the Research Medal awarded by the NZAS (2007). Her research expertise is in the areas of soft matter and biomineralisation. In particular she is interested in the fundamental molecular level control of 3D pattern formation in liquids and solids.

Vice-president

Dr James Renwick has worked in the area of climate and atmospheric dynamics for the past 30 years, beginning as a weather forecaster at the New Zealand Meteorological Service. He completed a PhD in Atmospheric Science at the University of Washington in Seattle in 1995. Presently, James leads the climate variability and change research effort at the National Institute of Water and Atmospheric Research Ltd (NIWA). He was a lead author on Working Group I of the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report, and is a co-recipient of the 2007 Nobel Peace Prize. He serves on the World Meteorological Organisation Expert Team on Seasonal Forecasting, and is a member of the Royal Society of New Zealand (RSNZ) Climate Committee and the RSNZ Council. His current interests include Southern Hemisphere climate variability and impacts of climate variability and change on the New Zealand environment.

Secretary

Dr Fiona McDonald is a Senior Lecturer in the Department of Physiology at the University of Otago. Fiona's research centres on a protein complex called the epithelial sodium channel, which is crucial to the kidney's ability to keep our blood pressure stable. She also teaches classes from 100- to 400-level and at the moment supervises three PhD students and a research assistant in her laboratory.

Fiona graduated with her BSc (Hons) degree in Biochemistry from the University of Otago, gained her DPhil from Oxford University under the supervision of Professor John Heath, and worked in a post-doctoral position in the laboratory of Professor Michael Welsh at the University of Iowa.

Prior to moving back to Dunedin she enjoyed five years as a lecturer in the School of Biological Sciences at Victoria University of Wellington.

Treasurer

Dr Janet Bradford-Grieve (FRSNZ, ONZM) retired from the National Institute of Water and Atmospheric Research Ltd (NIWA) in November 2004, but retains an emeritus role there. Janet has

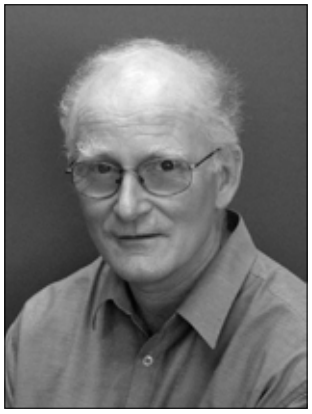
devoted much of her professional life to studying calanoid copepods – small aquatic crustaceans. These zooplankton are an important food source for many larval fish. Janet is also a strong advocate of interdisciplinary science, and enjoys integrating the work of biologists, ocean chemists, sedimentologists, and physical oceanographers to get a better appreciation of how whole systems operate. She was elected a Fellow of the Royal Society of New Zealand for her work as a New Zealand biological oceanographer and copepod systematist and taxonomist. Now she is retired, she continues with her work on copepod phylogeny and diversity and helps younger scientists who ask for assistance. Janet was appointed an Officer of the New Zealand Order of Merit in 2007 for services to marine sciences. She recently joined an international field programme aboard '*Polarstern*' in the Atlantic and continues collaboration with international colleagues.

Immediate Past President

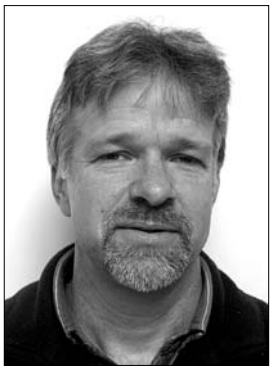
Dr David Lillis became, *ex officio*, the Association's Immediate Past President at the November AGM. However, because of increasing personal commitments, David resigned from Council in February 2008.

Council members

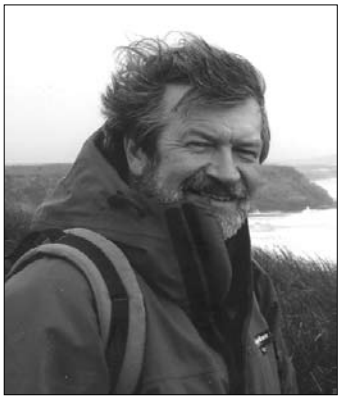
Research Professor Mike Berridge completed his PhD in Cell Biology at the University of Auckland in 1971. Following post-doctoral research at Purdue University, USA, and the National Institute for Medical Research, UK, Mike returned to Wellington in 1976 as the second Malaghan Research Fellow. He currently holds a Senior Research Fellowship with the Cancer Society of New Zealand, and recently held a James Cook Fellowship in the Health Sciences. He is a Past President of NZAS and an RSNZ Council member. Mike's current research at the Malaghan Institute of Medical Research concerns a stress adaptation and survival pathway in the cell membrane that has particular relevance to tumour cells, which is being targeted with small molecules designed to disrupt the pathway and eradicate cancer. Mike is also pursuing the elusive cancer stem cell, a minor population of quiescent, drug-resistant cancer cells that are thought to be responsible for the initiation of most cancers and their recurrence following treatment.



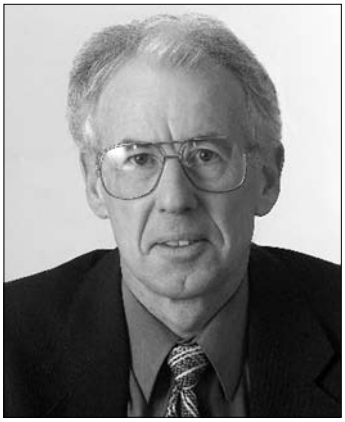
Dr Peter Buchanan works at Landcare Research, Auckland, leading the Biosystematics Team comprising taxonomists and ecologists studying plants, invertebrates, fungi, and bacteria. After graduating from the University of Auckland, Peter joined DSIR in 1977 as a mycologist, and has since specialised in taxonomy, ecology, and applied (edible) uses of fungi. He has a particular interest in wood-decay fungi, and more recently in the ecology of wood decomposition and forest health. In order to promote the relevance of mycology and taxonomy in general, Peter assisted in the establishment and organisation of the annual New Zealand Fungal Foray (now in its 22nd year), Fungal Network of New Zealand Inc., and since 2004 BioBlitz events promoting public awareness of biodiversity in urban parks and reserves. Peter contributes lectures in mycology at the University of Auckland.



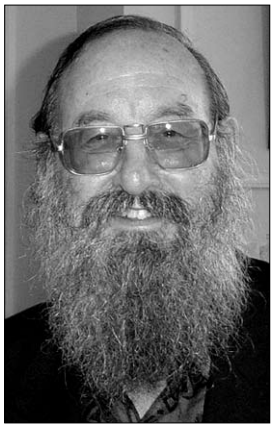
Dr Hamish Campbell is a Wellington-based earth scientist and is fully employed as a Senior Scientist within Strategy Group at GNS Science in Avalon (Hutt Valley). Under the auspices of a GNS Science sponsorship arrangement, he is also resident geologist at Te Papa and has been since it opened in 1998. Through this role he has become known as a science communicator. A New Zealander, he grew up in Dunedin and was educated in geology and palaeontology at Otago, Auckland, and Cambridge (England) Universities. His main research interests are concerned with the nature and origin of the Permian–Cretaceous basement rocks of New Zealand, the Chatham Islands, and the antiquity and origins of the native fauna and flora of New Zealand.



Dr John Clare is Project Leader, Photometry and Radiometry at New Zealand's national metrology institute, the Measurement Standards Laboratory of New Zealand (MSL), which is operated by Industrial Research Ltd at Graceville, Lower Hutt. John's principal areas of expertise, in which he has worked and published since 1987, are photometry, including the realisation of the candela and the theory of integrating spheres, spectrophotometry, radiometry, and the theory of noise in measurement systems. He has recently completed a two-year term as President of the New Zealand Institute of Physics and a further year as Immediate Past President. John chairs the New Zealand National Committee of The International Commission on Illumination – (Commission Internationale de l´Eclairage – NZ) and represents the Committee on CIE Division 2 – measurement of light and radiation. He is a Chartered Physicist (UK), a member of the (UK) Institute of Physics, the American Physical Society, and an Associate of the Illumination Engineering Society of Australia and New Zealand (IESANZ).

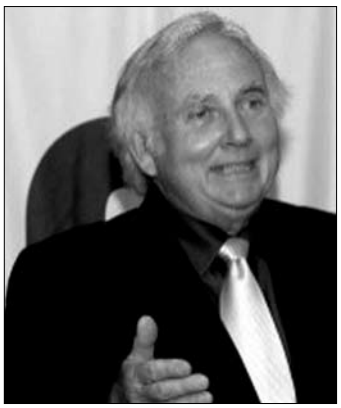


Dr Vincent Gray has a PhD in chemistry from Cambridge University and has had a long research career in the UK, France, Canada, China, and New Zealand in a variety of scientific research establishments. Vince came to New Zealand in 1970 as Director of Building Research and was subsequently with the DSIR Chemistry Division and the Coal Research Association. Since returning from China in 1991 he has specialised in climate science and is the most prominent independent reviewer of the publications of the Intergovernmental Panel on Climate Change who, in his opinion, have never succeeded in showing that carbon dioxide emissions harm the climate. He is an active member of the New Zealand Climate Science Coalition. Vince has been a member of the New Zealand Association of Scientists since 1970 and a member of the Council since 1998.



George Jones (BSc Otago (Physics), CRSNZ) initially worked as a scientist at DSIR, Lower Hutt, for ten years, including a year running scientific equipment in Antarctica. With a partner George formed an electronics company and became a technologist and businessman. He now runs the technology company Krypton Technology Ltd, retaining one of his previous clients. George has worked in many fields, and developed several world-first technologies. In a world of the specialist he is a generalist, applying the results of research in most sciences to his work. He has wider interests as well, including family and science and technology history. George emails the notification of the more than seven hundred talks and events every year in science and technology in the Wellington region to a thousand addresses, and helps organise a few of these.

Dr Dennis P. Gordon (FLS) is a principal scientist in NIWA's marine biodiversity and biosecurity group. He is a global authority on the classification, phylogeny, and biology of Bryozoa. This group of organisms includes many alien and fouling species and sources of marine natural products. Dennis is a past president of the International Bryozoology Association. More generally, he is a spokesman for biodiversity appreciation and is the coordinator of a multi-year project (The Inventory of New Zealand Biodiversity), involving more than 220 contributors around the world, that is reviewing and inventorying the entire biota from bacteria to blue whales and including fossils. The first of three volumes will be published this year by Canterbury University Press. Dennis is also a member of the international project team of the online Catalogue of Life, the principal names contributor to the Encyclopedia of Life. In 2005, Dennis was the recipient of the New Zealand Marine Sciences Society award for his contributions to marine science.



Dr Allen Petrey (Editor) is a veterinarian who has spent most of his career in the public sector both in New Zealand and elsewhere, but has dallied for periods in academia, private clinical practice, and state sector consultancy. At different stages of his career his professional interests have ranged from ethology, soft tissue surgery, epidemiology, public health, political economy and public management – courtesy of a somewhat protracted education at the Universities of Queensland, California at Davis, and Victoria University of Wellington. Allen's association with practising scientists commenced at the tender age of 16½ when he was employed as a Technical Assistant by CSIRO in Queensland and his observation of the 'species' has continued in one guise or another since then.

Dr Ken Richardson works in the Department of Public Health, University of Otago as a biostatistician researching the determinants of health inequalities. After completing a PhD in high-energy astrophysics at the University of Durham, UK, Ken worked in a variety of fields: gamma-ray astronomy (Durham), electromagnetics (GEC, UK), fisheries and remote sensing (NIWA, New Zealand) before joining the Health Inequalities Research Programme at the Wellington School of Medicine. He has a keen interest in improving the quality of the environment for research in New Zealand so that it remains a viable career choice for young scientists.

Dr Vanessa Sherlock (Webmaster) obtained a BSc (Hons) in Physics from Canterbury University in 1993. Vanessa then studied in Paris and obtained a PhD in Geophysics for her research on the measurement of upper tropospheric water vapour using Raman lidar in 1998. After working for two years at the UK Met Office on radiative transfer modelling for satellite radiance assimilation, Vanessa returned to New Zealand in 2001. Since then she has worked as a research scientist at

the National Institute for Water and Atmospheric Research Ltd (NIWA), contributing to projects ranging from satellite radiance assimilation in mesoscale models to the inference of nutrient availability in the upper ocean based on remotely-sensed temperature and chlorophyll concentrations. At present she leads the measurement programme for the New Zealand site of the Total Carbon Column Observing Network (TCCON), contributing to improved understanding of the global carbon cycle.

Research Associate Professor Chris Sissons is a microbial ecologist, researching dental plaque, its development and behaviour of its >1000 species, how to control it and counter the diseases it causes. Chris started research as a biochemist with an MSc in xenobiotic metabolism from Victoria University of Wellington. His PhD was in the molecular biology of yeast protein synthesis at Auckland, with a post-doc on the physiology of yeast cell-cycles at Edinburgh University. Returning to New Zealand, he held a Facial Eczema Fellowship at Ruakura, spent 2 years in the Thermophile Group at Waikato, then joined the MRC/HRC Dental Research Unit in Wellington. Currently Research Associate Professor in the Department of Pathology and Molecular Medicine, University of Otago, Wellington, he leads the Dental Research Group. Chris has developed a unique laboratory dental plaque model ecosystem, a sophisticated 'Artificial Mouth' with a range of novel molecular plaque analysis techniques and established the study of plaque 'microcosm biofilms.' These enable a wide range of environmentally-controlled experiments into plaque ecology and pathology. Major studies include effects of fluoride, antimicrobials on the oral microbiota, and plaque anticaries mineralisation.

News

Review of Australian Cooperative Research Centre Programme

In late January 2008, Senator Kim Carr, Australian Federal Minister for Innovation, Industry, Science and Research, announced a review of the Cooperative Research Centres (CRC) programme, as part of a broader review of the national innovation system. The CRC review will identify areas to further promote and encourage investment and collaboration between research and industry.

'The review will be comprehensive and will consider all aspects of the CRC Programme. It will examine the overall strategic direction of CRCs, looking at the full range of issues, including governance and program design issues, the level and length of funding needed to support the programme's objectives, as well as its overall scope and effectiveness.

'The Terms of Reference for the wider review of the National Innovation System are broad-ranging and will ensure a thorough and complete review of all elements of the CRC Programme is carried out.

'The Rudd Government is absolutely determined to restore public benefit as one of the primary objectives of the CRC Programme. This basic principle was stripped away by the Howard Government and it will definitely apply again from the next funding round,' Senator Carr said.

The CRC Programme review will be chaired by Professor Mary O'Kane, formerly Vice-Chancellor of the University of Adelaide and now executive director of the consulting firm Mary O'Kane and Associates. A Green Paper on the national innovation system (and the CRC programme) will be received from the review panels by the end of July 2008, and this will be followed by a White Paper response from the Government.

For more information on the review of the national innovation system and the CRC programme, see:

http://www.innovation.gov.au/innovation review, and

http://minister.innovation.gov.au/SenatortheHonKimCarr/Pages/REVIEWOFCOOPERATIVERESEARCHCENTRESPROGRAM.aspx

Selling science offshore – matching MBA students with start-up companies

Giving companies on the brink of international expansion a shot of business and marketing know-how is helping to deliver export wins for New Zealand. Since 2004, the Foundation for Research, Science and Technology (FRST) has been channelling brainpower from the MIT Entrepreneurship Centre in the USA into promising New Zealand companies.

Last year, the scheme went local, with final-year Master of Business Administration (MBA) students from the University of Auckland being matched with start-up companies seeking overseas opportunities. The programme is being offered again by the University of Auckland this year and is also being extended to the University of Canterbury.

One of the companies involved in the pilot, Senztek, is negotiating production of its water-heating technology with a Hungarian manufacturer and others are pursuing new offshore sales strategies as a result of the MBA students' work.

Both FRST and national economic development agency New Zealand Trade and Enterprise (NZTE) are supporting the scheme, as part of the cross-government drive to develop more globally competitive companies in New Zealand.

'It's about helping companies bridge the gap between developing smart science and technologies and selling it while also giving students hands-on experience in the real world,' says Foundation Sector Business Manager Tom McLeod. 'The students go in there with an independent eye and time to specifically focus on commercialisation barriers and strategies.'

NZTE ICT Sector Manager Martin Knoche says the New Zealand scheme follows the success of a similar programme involving creative and new media companies - NZTE's Global Access Programme with UCLA, which was initiated in 2002.

'The challenges for New Zealand businesses are around selling and creating the management expertise needed to create world class companies. By investing in these students we are building capability that will help us address both those issues with a longer term perspective,' says Mr Knoche.

The MBA students are selected through a rigorous vetting process, says Dr Maureen Benson-Rea, Senior Lecturer in the Department of Management and International Business at the University of Auckland Business School, who supervised all the projects.

'We are very particular about matching the right students with the right companies. We look at the experience and interests of individual students and their level of confidence and maturity. These students carry out a degree of due diligence on the company and it takes personal presence to challenge what a company is telling them and to ask the right questions.'

She says companies are also closely scrutinised to ensure they are at the right stage to take off in terms of international expansion. 'Their technology has to be ready to go and their business plans in place for the pairing to deliver results.'

Auckland company Step Sciences Limited set its two MBA students the tasks of identifying where and how it might sell new technology capable of naturally killing bacteria that can spoil wine. Director Lionel Evans says his initial reservations about how the students would fit with the wine industry proved unfounded.

He says they carried out extensive industry research into how the technology fits in the wine industry, identified that it is winemakers who decide whether to buy and install new technology, and interviewed a number of winemakers to understand attitudes to technology and purchasing decisions.

'They were able to hone their findings into a crisp one-liner: proof is what will sell this technology. I am an engineer, not a marketer or a wine connoisseur, so that in-depth look at the wine industry was vital for our commercialisation plans. The students were able to use their business and marketing knowledge to show us where our technology fits in the industry and who to pitch it to.

'We now have a comprehensive report on how to go forward, and one of the best things is that it's independent – and that carries weight with clients.'

Mr Evans says he was so impressed by the students' final presentation he invited them to deliver it to Logistics Solutions Board members and shareholders.

Bioinformatics company Biomatters asked its MBA students to advise on strategies that would boost sales of its Geneious software, which dramatically shortens the time needed for computer-based biological research by managing data and making it easier to share and compare information.

Since August 2006, a free version of the software has been downloaded by more than 80,000 scientists around the world, but Biomatters would like to increase the conversion rate from the free downloads to professional licence sales.

'With so many downloads we know the software is meeting a need, but we wanted the MBA students to find the trigger points that would make people buy it. There is lots of free software out there that scientists can use so we have to make ours so outstanding that we pull them over the purchase line.'

The MBA students completed a literature search, conducted an online survey of people who had already downloaded the software and travelled to the USA for meetings with key scientists in leading academic and research institutions. Issues researched including pricing, packaging, and the functionality potential buyers want.

Dr Brett Ammundsen, Chief Operating Officer for Biomatters, says the students' findings validated a number of strategies being considered by the company and gave it the confidence to proceed.

'For example, our software is very feature-rich and we had a concern that with all that functionality, the customer doesn't know where to begin. We are now working on improvements that break the information down and categorise it.'

The research also confirmed the importance of having the software validated by reputable scientists through citations in publications. 'We knew this was important but hadn't realised quite how important in the purchasing decision. But it's a challenging issue with new software because it might be years before research that uses our product is completed and the results published.'

Dr Ammundsen says being allocated students who had health backgrounds (one in audiology and the other in cardiology) was an advantage for the company as they were comfortable going into scientific environments.

The students' work contributed to their university qualifications but also had more far-reaching impact, says Dr Benson-Rea.

'The projects integrate all the various parts of the learning they do for an MBA, from financial principles through to marketing theory, in a real, live actionable programme.

You can't beat that experience. It has helped clarify for those students what they want to do. Some are going off in new directions, with one deciding to focus on the commercial rather than technical aspects of business and setting up his own business and another going to do a PhD.'

Tom McLeod says one of FRST's goals in supporting the programme is to get MBA students interested in working with small businesses and helping to turn them into world-class firms.

'It's also about networking. We have really good universities in New Zealand, with outstanding knowledge and research capability, and we want greater engagement between them and businesses at all levels.'

NZTE's Martin Knoche says another important feature of the scheme is that it involves business mentors and academic advisors, giving it a commercial perspective as well as an academic focus.

More information on this scheme may be found at http://www.frst.govt.nz/

New Zealand Association of Scientists (Inc.)

Statement of financial performance for the year ended 31 July 2007

	2007	2006
Income was derived from:		
Subscriptions received	12,576	10,730
Interest received	1,087	1,221
Scienc Review sales	4,490	0
Contribution ot Survey 2007	10,000	0
Donations and sundry	134	0
	$28,287	$11,951
From which Expenses were deducted:		
Accountancy and Audit	788	600
AGM and Conference expenses	0	114
Awards and costs	701	145
Councillors' expenses	742	268
Depreciation on printer	1	65
Postbox rent	125	125
Royal Society affiliation	669	669
Survey 2007	10,650	0
	$13,676	$1,986
Excess Income over Expenditure	14,611	9,965
Appropriation – Subsidy for NZ Science Review	11,279	9,397
Surplus for the year	$3,332	$568

New Zealand Science Review

	2006		2005
Expenses of production and administration:			
Accountancy and Audit		75	69
Production			
Printing, etc.	10,073		13,165
Distribution	1,565		1,477
	11,638		14,642
Last year stock adjustment	3,423		–3,423
		15,061	11,219
Total expenses		$15,136	$11,288
Expenses recovered from:			
Library subscriptions and other revenue		5,739	4,093
Subsidy from NZAS		9,397	7,195
Total recoveries		$15,136	$11,288

Statement of financial position as at 31 July 2007

Accumulated funds

	2007		2006
General funds			
Balance at 1 August beginning of financial year	28,946		28,378
Prior period adjudtment	(825)		0
add Surplus for the year	3,332		568
Total funds		$31,453	$28,946
Represented by:			
Assets			
Fixed assets –			
Printer at cost	1,639		1,639
less Cumulative depreciation	1,639		1,638
		0	1
Current assets –			
BNZ current account	14,142		9,083
BNZ short-term deposits	18,826		17,898
		32,968	26,981
Subscriptions in arrears	913		2,105
Stock of medals at cost	362		543
		1,275	2,648
Total assets		34,243	29,630
less **Liabilities**			
Current liabilities			
Accounts payable		2,286	0
Graeme Coote Fund Donations	0		414
Subscriptions in advance	504		270
Total liabilities		2,790	684
Total net assets		$31,453	$28,946

Auditor's report to members

We have conducted the audit in accordance with generally accepted auditing standards in New Zealand.

We have obtained all the information and explanations we have required.

In our opinion the financial report fairly reflects the results of operations and the financial position of the Association as at 31 July 2007.

Our audit was completed on 13 September 2007 and our unqualified opinion is expressed at that date.

Austad Willis Evans & Co
Lower Hutt
13 September 2007