Article

A better way: New Zealand Association of Scientists 1992–2016*

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... the effectiveness of the policy/funder/provider separation principle is now in question and the efficacy of information sharing and joint policy development of these parties is in doubt.

From: 'There is a better way', 2005 [1].

Prologue

At the turn of the 1980s in the wake of the 1979 energy crisis, most of the developed world had suffered economic recession, which was then aggravated by the 1987 stock market crash. As part of the general economic stringency controls that ensued, governments of most OECD countries increasingly involved themselves in determining scientific research priorities in terms of value for the investment of taxpayers' money. The UK, for example, having accepted Lord Rothschild's 1972 proposal of applying the customer/contractor principle to government-funded science [2], required government-funded scientists to justify their work in terms of economic and social benefits for the nation. Under Margaret Thatcher's premiership, in 1987, the separate centralised overseeing organisations, ACOST (Advisory Council on Science and Technology), which would control and direct research funds and priorities, and CEST (Centre for Exploitation of Science and Technology), which would identify priorities [3], were formed, and government research institutes were restructured and in several cases amalgamated or closed. The main criteria for research funding became selectivity and exploitability [4].

In New Zealand, too, sweeping economic changes initiated by the Labour Government in the mid-1980s and continued by the National Government from 1990, contained similar changes for government-funded science. The customer/contractor principle was elaborated to identify these and other potential areas of conflict of interest which it was considered desirable to separate: policy advice, purchase of services, ownership of provider organisations, and provision of services [5]. By 1990, the Ministry of Research, Science and Technology (MORST), responsible for policy, and the Foundation for Research, Science and Technology (FRST), responsible for the purchase of science services, had been established. The main government research department, the Department of Scientific and Industrial Research (DSIR), had moved towards self-assessment by means of performance indicators; it had also amalgamated its 22 research divisions into 10 new divisions rebranded in terms of commercial outputs [6], but this was insufficient to prevent the government from pushing ahead in 1992 with restructuring DSIR and the research sections of the Ministry of Agriculture and Fisheries, the Forestry Department, the Meteorological Service, and other departments as Crown research institutes (CRIs). These were owned by the state, and charged with providing science to industrial clients or by competitive bidding for projects to be funded by FRST [7]. All of these changes were a major preoccupation of the New Zealand Association of Scientists (NZAS), involving its Council members in numerous meetings with politicians and officials and in preparing submissions on a wide range of policy issues [8].

Following the facilitated internal review of its priorities in 1989, NZAS Council decided that it would concentrate its efforts on science policy, making issues of current concern the subject of annual conferences [9]. These would be published in the Association's journal, *New Zealand Science Review*.

Science for the 21st Century?

At its 1991 conference on Science for the 21st Century, NZAS had invited government officials and ministers to explain current changes, and affected scientists and other commentators to elaborate on the effects they perceived. Dr Basil Walker, Chief Executive of MORST, emphasised that key elements demanded of CRIs would be to focus on outputs and contestability [10].

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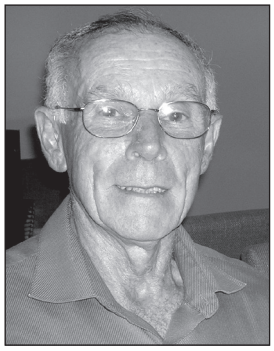
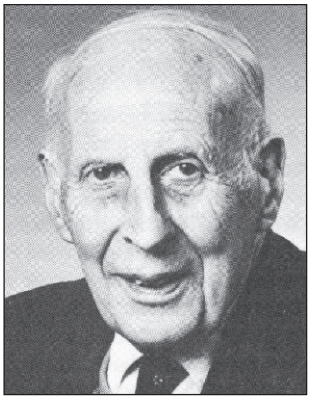


Geoff Gregory has been a science editor and writer for over 50 years. In New Zealand he worked for the Department of Scientific and Industrial Research from 1972 until early retirement in 1994, since when he has worked as a freelance. He was on Council of the New Zealand Association of Scientists from 1973 to 1991, and was honorary editor of *New Zealand Science Review* from 1974 to 1984. He has been production editor for this journal since 2002.

The Public Good Science Fund (PGSF) was subsequently defined as being 'relevance oriented', and access to all comers, including the tertiary education sector, was scheduled for implementation in 1993/94 [11]. At this conference, too, NZAS 1990/91 President Professor David Penny outlined results of a survey of NZAS members which showed that, although there was considerable goodwill towards the intent of the changes to research administration, problems included lack of effective consultation in setting priorities and in the bidding and refereeing process. There were worries about retention and recruitment of good staff. Centralising policy and grant allocation components in MORST and FRST conflicted with the need for CRIs to both manage themselves as businesses and to compete with universities [12]. The 1992 NZAS conference followed up on the problems of management and the exclusion of researchers from it under the new system [13]. Its presentations [*New Zealand Science Review*, 1992, vol. 49(4)] covered changes in the business environment and style of management required for science, as well as accounts of successful management of research from managers of several research organisations, including the new CRIs.

MORST had set up a Science and Technology Expert Panel (STEP) in that year to recommend long-term funding priorities, and NZAS made submissions to both the Panel itself and its subsequent discussion document [14]. In his NZAS Presidential address for 1992, Dr Alan Kirton, noting the 'curious' removal of CRIs from the process of establishing their research directions, enlarged on the Association's criticisms of STEP's 40 output classifications, and expressed concerns over the rushed and superficial nature of the STEP report [15]. Dr Kirton subsequently reported on the Association's meetings with the Minister of Science to discuss the entry of universities into the PGSF bidding, and with the Minister of Education to discuss some of the adverse effects of educational changes on the production of young scientists [16].

The changing expectations for science revealed at this conference made the Association decide this should be the subject of its 1993 Conference, which aimed to hear from representatives of different organisations that used science [*New Zealand Science Review* 1994, vol. 51(1)] The NZAS convener of its Organising Committee, Dr Chris Sissons, cited by the editor of *New Zealand Science Review* in the issue containing the proceedings of this conference [17], hoped that the conference would 'identify the problems that have emerged through restructuring and create a will on all sides to work towards a mutually satisfying solution'. The conference also contained affirmation of the benefits of the new period of stability that New Zealand public science was entering, with a guarantee of 5-year maintenance of the PGSF level from the Minister of Research, Science and Technology, Hon. Simon Upton, who said that 'the Government had made it clear that it is not seeking financial dividends from CRIs … The real dividend the Government seeks … is the science itself' [18]. The Minister was supported by the Opposition Spokesperson on Finance [19]. However, despite bipartisan political recognition of the 'need for greater innovation including research and development ….at least outside Treasury circles', the Prime Minister acknowledged that CRI funding was up to 45% less than in other developed countries. NZAS 1992/93 President Alan Kirton pointed out and highlighted other continuing causes of instability for scientists [20].



Dr Brian Shorland, Patron of NZAS from 1987 until his death in 1999. He was a long-serving Council member, and Hon Editor of *New Zealand Science Review* from 1986 until shortly before his death. The NZAS Shorland Medal, awarded in recognition of major and continued contributions to basic or applied research that has added significantly to scientific understanding or resulted in significant benefits to society, was created in his honour in 1998.

Acknowledging the continuing 'messages of concern and anguish from many working scientists' NZAS Council decided in 1994 to conduct a survey of perceptions of the scientific environment by the scientists themselves, and circulated 2569 questionnaires via Royal Society of New Zealand (RSNZ) and NZAS mailing lists [21]. From the detailed statistical analysis of the 837 responses (33% return), it was concluded that the changes had had a marked effect on both the scientists and their research. Science management was 'of great concern to most scientists, as was the effect of the changes on the provision of science and on international regard.' However, 'recent Budget changes in favour of science [had] begun to change scientists' perceptions for the better after a decade or more of declining science funding and restructuring' and it was hoped that science providers and government could 'work together for a brighter future…' [22]. In the issue of *New Zealand Science Review* reporting the results and the NZAS conference at which they were discussed, there is also a report on pressures on scientists in Australia, with a Senate Inquiry Report, *CSIRO: The case for revitalisation*, recommending that the CSIRO Board urgently address staff problems that included employment insecurity, excessive accountability, stresses of fund raising, and low morale [23].

The Government's broad vision for research, science, and technology (RS&T), set out in 1995 in a MORST publication, RS&T:2010 [24], was to foster societal attitudes recognising S&T as critical to future prosperity, to show that government had a major role to play in the sciences, to ensure an adequate level of investment in science, and to maximise the direct contribution of S&T to diverse social, economic and environmental goals [25].

The National-led coalition Government that came into power in 1996 had brought no change to this emphasis. MORST followed an initiative by the Australian Science and Technology Council (ASTEC) in launching its Foresight Project in 1998 [26], seemingly regardless of the fact that the Australian Government had ignored their project and abolished ASTEC soon afterwards [27]. The MORST project involved various sectors as well as scientists in suggesting where the Government should 'invest in' (rather than 'fund') RS&T to achieve target outcomes for a 'knowledge economy' [28]. The resultant *Blueprint for Change* [29] was criticised for its superficial approach and impenetrable language, and NZAS expressed concern over both the time and resources put into a process that had produced only 'motherhood and apple pie' and the staff implications of shifting funds from one area of research to another [30].

In 1999, the Association had, as usual, brought out a special election issue of *New Zealand Science Review*, containing science policies of the main political parties, and an editorial

maintaining that research is more vital than ever, but remarking that 'It is not our role here to comment on individual policies' [31]. Nevertheless, NZAS Council subsequently reported on visits to the newly elected Ministers of Science and Education at which they summarised the 'serious problems' that had been experienced from the 'flawed policies of previous governments' [32]. The Association was able to back up these criticisms with the results of their 2000 Survey of scientists and technologists [33,34].

Following the visit, NZAS wrote to the Minister about the 'poor quality, misleading advice' provided to the Government by Treasury, which seemed to be 'too focussed on growing the economy' and to not take into account 'the nature of the public good, particularly in areas of environmental research' [35].

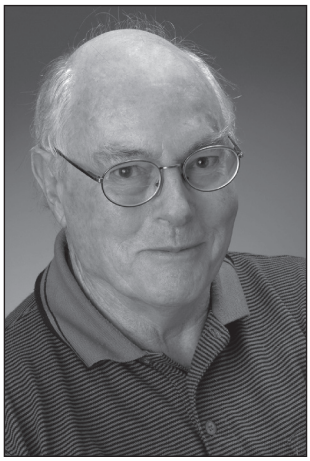
In 2002, after a review of the tertiary education system by the Tertiary Education Advisory Commission (TEAC), the Government introduced Centres of Research Excellence (CoREs) as inter-institutional research networks in selected fields to encourage the development of excellent tertiary education-based research that was collaborative, strategically focused and long-term, and promoted by knowledge transfer activities [36]. NZAS supported these, although funding was fully contestable, thus denying a major concern of theirs. In Australia, the Federal Government introduced National Research Flagships, large-scale multidisciplinary partnership between the Commonwealth Scientific and Industrial Research Organisation (CSIRO), universities, and the private sector, starting with three Flagships in 2003 and building towards eleven [37]. This required a substantial reorganisation of CSIRO, which continues today.

Following up on all of these issues, NZAS put together a special science policy issue of *New Zealand Science Review* in 2003, providing a platform for all of the key 'players' involved in various aspects of the New Zealand science system. From this the Association noted lack of clarity over strategies outside the sectors producing economic outputs and that the priority-setting process had been 'bureaucratised and politicised in recent years, largely excluding working scientists' [38].

MORST continued to produce policy initiatives such as the i^3 Challenge [ideas, innovation, investment] in 2003, but struggled with the difficulty of directly linking research to outcomes; it was asked by the Parliamentary Education and Science Committee to publish 'annually in plain language' the indicators of progress it had developed [39]. Former NZAS President Dr Janet Grieve showed how these policies neglected and even subverted research in the environmental sector [40].

In 2004, aspects of the funding process and the threat to science careers were the subject of an open letter to the Minister of Science from the Public Service Association (PSA) to which NZAS was a signatory [41], and this and press releases by NZAS in the election year of 2005 raised public awareness of scientists' concerns [42]. By this time, the Marsden Fund and PBRF had a three-year cycle, CoREs had a four-year cycle, and FRST had a four- to six-year cycle; The Marsden Fund was 10 times oversubscribed and the FRST system three to five times oversubscribed [43].

NZAS Council produced a major policy discussion document, 'There is a better way' in 2005 [44], notable for its constructive and objective comment, and it had a big impact, developing 'healthy lines of communication with MORST and FRST' as well as other organisations [45]. This called for an increase in public funding of RS&T, including excellence-based research for recipients of the Marsden Fund, to bring it in line with the OECD benchmark average percentage of GDP. It also suggested improving 'system coherence' and simplifying and clarifying the roles of different public-funded institutions in the RS&T system [46].



Emeritus Professor Neil Curtis has been Patron of NZAS since Dr Brian Shorland died in 1999. Dr Curtis was recipient of the NZAS Marsden Medal in 1994, and has been active for many years in NZAS activities, notably as Chair of the Awards Subcommittee.

Later that year MORST circulated a draft consultation paper, 'A More Stable Funding Environment', to 'stakeholders', including NZAS, RSNZ, the PSA, and the New Zealand Institute of Agricultural & Horticultural Science, in response to which a delegation of NZAS Council members met officials to discuss concerns. These were taken into account, and ultimately the Minister of RS&T, Hon Steve Maharey, announced provision for long-term multi-year funding to commence in 2006/07, with up to 30% of government investment in the New Economy Research Fund, the Research for Industry Fund, and the Environmental Research Fund, being non-contestable. The Minister also announced an increase in investment and an intention to move towards the OECD average by 2010 [47].

Biomedical research, 1990–2007

The Health Research Council (HRC), created under the HRC Act 1990 to give greater prominence to public health research, replaced the Medical Research Council; it had four committees: Biomedical, Public Health, Mäori Health, and Ethics, the first three of which were mandated to disburse research funding. In its 1989 submission on the Report of the Review Committee on the Organisation and Funding of Biomedical and Health Systems Research in New Zealand, *Research for Health*, NZAS had supported the intention to improve public health research in New Zealand, but affirmed the need to also maintain and increase funds for basic biomedical research for long-term effectiveness of health delivery [unpublished submission 10/8/89].

After release of the Government's draft science policy document, *RS&T: 2010*, NZAS decided to address biomedical research at its 1995 Conference. At this conference, NZAS President Dr Chris Sissons, spoke of biomedical research being seriously underfunded and 'arguably the area of New Zealand science which is under the most threat of disintegration, with the greatest long-term consequences'; this resulted from 'increasingly savage competitiveness and insecurity of fund allocation [48]. Facts about expenditure by the HRC were presented by its Director, Dr Bruce Scoggins, who spoke of the gap between the base funding it had for biomedical research and the amount required to support most of the projects applied for; some of this had been made up by cost-sharing with organisations like the Lotteries Board, Cancer Society and Heart Foundation and bequests [49]. The problems were discussed in panel sessions, transcripts of which were published [50] and from which

the NZAS conference organisers, Drs Sissons and Berridge, prepared the basis of a communique to government [51]. This summarised the crisis in biomedical research and called for immediate and substantial supplementary funding, and inclusion of biomedical research in the 'science envelope' fund through Vote RS&T (instead of Vote Health) administered by the Biomedical Research Committee of HRC. A postscript added in proof to Dr Scoggins' paper (mentioned above) reported the HRC had received a 30% increase in its funding for the following triennium.

In the decade after that, albeit from a changed funding basis, the three-term Labour government claimed to have increased Health Research funding by 130% [52].

Plans for the recovery of New Zealand science

In its 2007 review of New Zealand's innovation policy, the OECD, while commending the capabilities of public research institutions, criticised the fragmented system of government support for R&D and innovation, the lack of corporate enthusiasm for innovation, and the inadequate incentives for public research organisations with competitive funding [53]. It recommended improving incentives for commercialisation and keeping scientist salaries under review, moves all supported by NZAS [54].

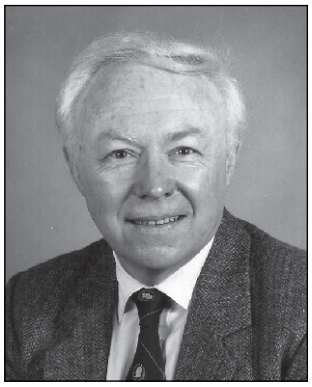
That year RSNZ had created a National Science Panel of thirteen distinguished scientists, chaired by Dr Jim Watson [55], which in 2008 produced 'A Science Manifesto: or plan for the recovery of New Zealand science', containing ten initiatives 'central to renewing our national science system' [56]. It was applauded by NZAS [57], who urged government to take it seriously and 'work with the science community to maximise the benefits of science for the broad national good'.

In what NZAS 2007-09 President, Dr Kate McGrath called 'a reasonably bold move', the Government had changed its ministerial portfolios in late 2007, making Hon Pete Hodgson Minister of Economic Development, Tertiary Education, and RS&T, thereby creating what amounted to a 'Ministry of Innovation' – a pointer of things to come [58].

In a pre-election issue of *New Zealand Science Review* containing science policy statements of political parties, Labour proclaimed the strong growth in funding of basic sciences through the Marsden Fund (90%), Health Research (130%), and the New Economy Research Fund ($5 m to $73 m) over the previous decade when it had been in power, and promised more to come [59]. However, National, which had promised a more stable funding environment and minimising bureaucracy and compliance costs [60], won the 2008 election.

Meanwhile, NZAS had completed its 2008 Survey of New Zealand scientists and technologists and received the aggregated preliminary results, which were to be 'shared with the main stakeholders shortly' (late 2008) [61], although the full survey was not published until 2010 [62]. They showed a sorry picture. Scientists were more concerned about 'interruptions to research funding' and 'bureaucratic accountability' than in earlier surveys conducted in 1996 and 2000 [63,64] and a large majority disagreed that 'government science strategy (was) open and inclusive of a large section of New Zealand scientists' [65].

The financial crisis of 2007-09, also known as the 'global financial crisis' intervened at about this time, and NZAS Council commented that the 2009 budget baseline increase in science investment of 2.5% was 'modest' compared with Australia's



Professor Jack Sommer was made an Honorary Member of NZAS in 2009. He is Knight Distinguished Professor of Public Policy Emeritus at the University of North Carolina, Charlotte, and he conducted NZAS and RSNZ Surveys of New Zealand Scientists in 1996, 2000, and 2008.

Ross Moore, who chaired the organising committee for the NZAS 2008 Survey, was also made an Honorary Member of NZAS in 2009.

increase of 25%, and this did not 'bode well for a timely, science and innovation-fuelled economic recovery' [66]. NZAS did, however, welcome increases to the Marsden Fund and HRC of 25% and 13%, respectively, as well as the appointment of a Chief Science Advisor to the Prime Minister, Professor Sir Peter Gluckman, and the Prime Minister's Science Prizes of $1 million per year [67]. The Primary Growth Partnership Scheme was to replace Labour's Fast Forward Fund [68].

In 2009, the government created a CRI Taskforce, and the Association made an extended submission to it [69]. While welcoming the review, it criticised its narrow scope and limited timeframe. Citing its 2008 Survey findings about the 'discontent that pervades the operational ('lab-bench') end of New Zealand's science system', it considered that 'policy makers appear to be attempting to 'fine-tune' the existing system without willingness to address the real problems that are crippling it'. It quoted up-to-date literature on research leadership and management in public sectors, and concluded that there should be a comprehensive review of the way the whole science system is operating [70]. The NZAS response to another MORST document, on RS&T priorities, similarly criticised its proposed realignment of funding instruments as merely a realignment with no evidence of how it would lead to gains [71]. When the CRI Taskforce's report appeared, NZAS 2009/10 President Dr James Renwick observed that it echoed many of the concerns identified by NZAS and proposed some structural changes to public science management, many of which the Government was prepared to implement [72].

Even more change

The greatest changes to the New Zealand science system in twenty years began in 2010 when the government created a bi-institutional framework for making its investment decisions in science, by amalgamating MORST and FRST into one organisation, the Ministry of Science and Innovation [73]. At the same time, significant changes to CRIs were implemented to provide greater clarity on their role, increase strategic and long-term funding, strengthen CRI board accountability, and assess scientists' performance by panels of their peers [74].

NZAS took the opportunity of organising its 2010 Conference to cover 'Re-setting science and innovation for the next 20 years' and elucidate the role of innovation in the economy and why the pursuit of economic goals should not lead to neglect of environmental, health, and social sciences [75].

In 2012, the government decided to follow moves taken in Australia and the UK to establish a 'single, focused business-facing government department' to help to build and drive a 'more productive and competitive economy', by combining the

newly formed Ministry of Science and Innovation (MSI) with the Ministry of Economic Development and the Departments of Labour and Building and Housing to form a Ministry of Business, Innovation and Employment (MBIE) [76]. NZAS 2012/13 President Prof Shaun Hendy issued a press release stating that the exclusive focus on economic growth would make 'no sense in terms of environmental science for environmental sustainability or in terms of health science to improve the wellbeing of New Zealanders', and would 'only further destabilise an already splintered … science sector' [77]. As a result of these changes, there was no funding round in 2011 and a severely disrupted one in 2012, a situation which Prof Hendy likened to 'reinventing a wheel that may be a good deal less effective than the one we were running on a few years ago' [78].

The government took steps to tighten still further its control of publicly-funded science by introducing ten National Science Challenges in 2013/14 to 'provide opportunities for innovation and business development on the world stage' and redirecting its funding to these ten areas to the tune of $133.5 million over four years [79]. This was followed in 2014 by a draft National Statement of Science Investment (NSSI), designed to produce a 'better-performing science system that is larger, more agile and more responsive …' with a single contestable fund and bidding every year [80]. The Association's response to NSSI was guarded: NZAS 2013/14 President Dr Nicola Gaston said that it needed to grapple with 'issues of career stability, of equity and diversity in the science sector, an awareness of how funding drives individual behaviour, and an understanding of the changing nature of the scientific workforce' [81]. Dr Gaston took the Minister of Science and Innovation to task for saying that 'Crown research institutes are about commercial science – that's why they're there', which was in apparent contradiction of the Crown Research Institutes Act, 1992 [82], and not the intention as expressed by Hon. Simon Upton, cited above. NZAS 2015/16 President Dr Craig Stevens posted a media release about the 2016 Budget, hoping that the initiative would stick with the 'laudable' NSSI goals and support 'impact in the environmental and social sectors and not just research with direct economic returns' [83].

Scary issues

The Association's 2008 Survey of New Zealand scientists and technologists had sought opinions about what it called 'scary issues' – widely reported controversial science-based topics, including genetic modification (GM), nuclear power, and global warming [84]. Although NZAS had earlier declared that it did not generally 'scientifically scrutinise and evaluate specific scientific issues', it had engaged with the risky proposal to import calicivirus for rabbit control because of the secrecy and apparently inadequate peer review process being used by MAF [85]. Subsequently it confronted the whole issue of risk assessment and issues with a risk component, producing a position paper on GM and a discussion paper on climate change.

Rabbit calicivirus, viral haemorrhagic disease

In 1996, the Ministry of Agriculture and Fisheries (MAF) received an application for approval to import rabbit calicivirus disease (RCD), also known as viral haemorrhagic disease, as a biological control agent for the rabbit problem in parts of semi-arid country in the South Island.

The Association's own peer reviews, independent of those done by MAF, led it to strongly oppose introduction of RCD because of uncertainty about its effectiveness and ecological effects and the consequent risks to humans, farm animals, and wildlife [86]. In the event, MAF declined the application, but a group of farmers illegally imported infected rabbits and spread the virus deliberately. The government then sought to pass a Bill to retrospectively legalise the possession and spread of the virus, which NZAS Council strongly opposed. In view of the lack of independent advice to government from scientists in the CRIs, the Association decided to organise a conference covering all aspects of this controversial issue [87]. NZAS 1993-96 President Dr Chris Sissons and 1998-2000 President Dr Janet Grieve successfully persuaded participants from all sides to present their viewpoints, despite reluctance by some, and also received expert scientific contributions from the USA, UK, Austria, and Australia.

Besides showing the integrity of NZAS in the manner of their involvement, the conference highlighted the need for openness and freedom of information in the conduct and review of science [88]. It also examined the role of the Government's ministers and executive branch and the place of interest groups in the decision-making process [89]. Finally, there was a statement about the role of the newly created Environmental Risk Management Authority, ERMA [90]. The proceedings were compiled by NZAS 1996-98 President Dr Brion Jarvis and published with assistance from RSNZ as *RSNZ Miscellaneous Series 55*.

Risk assessment

Involvement in the debate over introduction of RCD made NZAS Council members 'uneasy' about how judgements about risk were made when scientific facts were uncertain or contested, and this was one reason for the decision to address the topic of risk assessment in their 1997 annual conference, the other being a precedent set by the Royal Society (of London) conference in March 1997 on the subject of 'Science, policy and risk' [91]. It was timely for New Zealand, as the Hazardous Substances and New Organisms Act 1996 (HSNO Act) had just been passed, to provide a legislative framework for decisions which ERMA would make on managing hazardous substances and introducing new organisms, including genetically modified ones [92].

In the USA in the 1970s, public alarm about nuclear technologies had led some scientists to try to evolve quantitative methods of risk analysis, and the Society of Risk Analysis was formed in 1980 to facilitate exchange of ideas and publish an international journal, *Risk Analysis*, the first issue of which appeared in 1981 [93]. The quantitative definition of risk [94], however, made little allowance for 'acceptability' and none for 'perception' of risk, and its use was criticised in an acclaimed analysis urging consideration of emotional and psychological aspects of risk perception in risk assessments [95]. By 1997, the NZAS conference was told that there were still 'two clearly opposed camps: those who have great faith in quantitative assessments of risk, and those who have no faith at all.' [96]. In a preliminary 'think piece' by the its new Chief Executive, a guiding principle of ERMA was stated to be to use 'a rigorous scientific assessment of available evidence, but to take account of community views of risks, having regard to the strength of those views and the degree of certainty in the scientific evidence' [97].

The conference also heard about specific biosecurity examples, including the NZAS position on RCD mentioned above,

and bovine spongiform encephalopathy (BSE) and the 1996 scare about its link to human Creutzfeldt-Jakob disease; as well as natural hazards assessment; the risk of overfishing; and global environmental hazards.

Genetic modification

According to Hon Simon Upton, the Minister for the Environment at the time of ERMA's formation, a major function of ERMA was 'to provide the legislative tools for the community to control genetic manipulation' [98]. NZAS had earlier supported the concept of a Statutory Body to oversee GM experiments [99], and, as mentioned above, in its risk assessment conference gave ERMA's inaugural Chief Executive an opportunity to comment on its possible *modus operandi* [100], which was being developed with public consultation prior to the HSNO Act coming into effect in 1998.

Although scientists in some CRIs such as AgResearch and Crop & Food Research were promoting laboratory and field experiments in GM, other scientists were concerned about potential environmental and biodiversity impacts of GM crops and damage to New Zealand's 'clean, green' image and organic crops industry, reflecting a 'lively debate' in the wider community [101]. Moreover there was a range of ethical, cultural, and religious views about all GM experiments in animals that was brought to the attention of parliamentarians by the Parliamentary Commissioner for the Environment in a report specifically about use of GM to control possums [102]. At the same time, a petition calling for a Royal Commission and signed by 92,000 people was presented to Parliament. An Independent Biotechnology Advisory Council set up by the Government in 1999 received submissions from a variety of organisations, including NZAS, and commissioned a survey of public views on the 'biotechnology question', summarising the diversity of views and the need for clarifying the technology [103]. Finally, in 2000, the incoming Labour Government established the Royal Commission on Genetic Modification (RCGM), mandated to consult widely with the public in a way that allowed people to express their views clearly [104].

NZAS 2000/02 President Dr Mike Berridge was asked by the RCGM to prepare a background paper on human health aspects of GM, and this was published in *New Zealand Science Review* [105]. Identifying several GM medicines in use in New Zealand, Dr Berridge wrote of the need to allay public fears by better communication and provision of factual information and realistic evaluation of benefits and risks. The Association presented its own position paper on GM to the Commission, saying that 'communication is paramount' and 'the more widely the issues are discussed, the more knowledgeable and more rational decisions will be made' [106].

The Commission's report included 49 recommendations on the theme of preserving opportunities but proceeding carefully and minimising and managing risks [107]. NZAS published a summary of its findings by one of the Commissioners, Dr Jean Fleming (a former Council member of NZAS) [108] and also NZAS Council's commentary on them [109]. One recommendation led to the establishment in 2002 of the Bioethics Council, which successfully encouraged widespread public discussion of contentious scientific issues and may have facilitated trials of xenotransplantation of insulin-producing pig cells and a GM vaccine for equine influenza [110]; however, the Bioethics Council was abolished by the National Government in 2009.

In the NZAS 2008 Survey of scientists and technologists, 60% of respondents disagreed with the notion of suspending research endeavours in GM, and 63% with suspending embryonic stem cell research, while 46% agreed with government investing as much in research on organic foods as on GM foods; proportions differed between scientific disciplines [111].

As of 2013, 'only two GM field tests are in operation in New Zealand, but there have been 57 since 1988.' [112]. The Association has made no recent pronouncements on this topic.

Global warming – climate change

A succession of events in 1988 made global warming, also labelled climate change, an international political issue. An unprecedented heat wave in the USA prompted National Aeronautics and Space Administration scientist, James Hansen, to declare to a US Congress hearing that global warming had begun, and a *New York Times* report on this made worldwide news [113]. Then a World Conference on the Changing Atmosphere, held in Toronto and attended mainly by scientist experts, concluded that the changes in the atmosphere due to human pollution 'represent a major threat to international security and are already having harmful consequences over many parts of the globe', and called on the world's governments to set strict, specific targets for reducing greenhouse gas emissions [114]. Later in the year, UK Prime Minister Margaret Thatcher, a chemistry graduate, was the first national leader to respond, in a speech to the Royal Society [of London], of which she was a Fellow, expressing her commitment to research on climate change [115]. Finally, the World Meteorological Organization and the UN Environment Programme collaborated in creating an *Intergovernmental Panel on Climate Change* (IPCC), consisting of scientific experts who were also official representatives of their governments; IPCC, which has become recognised as the authoritative source of scientific information on climate change, was awarded a Nobel Peace Prize in 2007 (shared with former US Vice-President Al Gore), after publication of its 4th Assessment Report [116]. A year after IPCC was established, a powerful alliance of fossil-fuel industries, the Global Climate Coalition, was formed to lobby against political action to control carbon dioxide emissions. It was particularly influential in the months leading up to the UN Kyoto Conference on Climate Change in 1997, which developed the Kyoto Protocol, the landmark international treaty committing signatory nations to setting programmes to reduce carbon dioxide emissions [117]. However, the Coalition subsequently declined in influence with increasing recognition by several of its members that global warming was a reality [118].

NZAS initially hesitated to enter this controversial domain, although *New Zealand Science Review* published an article by an outspoken self-styled 'expert reviewer' and critic of IPCC and its findings in 1996 [119] and a paper supporting the IPCC's work in 2001 [120].

The topic remained controversial in New Zealand for the next decade and beyond [121], although the anthropogenic causes became more widely accepted and the IPCC's results became recognised. It was a source of 'heated debate' within NZAS Council; by 2007, NZAS President Dr David Lillis expressed a hope that the Association would be able to form 'a clear view and articulate its position publicly' [122]. The NZAS discussion paper that was produced soon afterwards [123] concluded that the evidence for accelerated warming induced by human

Dr Janet Bradford-Grieve (aka Grieve) was made an Honorary Member of NZAS in 2013. She was NZAS President from 1998 to 2000, and Treasurer from 2006 to 2009, an active contributor to many of the Association's public position papers, and co-convenor of several NZAS conferences. She was also foundation Secretary/ Treasurer of the Association of Women in the Sciences.

activities was overwhelming. It saw this as an opportunity for investment in research, energy-efficient industries, renewable energy businesses, enhanced sustainability practices, and wider economic benefits. The dissention referred to by Dr Lillis may be presumed to have been caused by the presence on Council of the above-mentioned critic of IPCC, who published a scathing criticism of the NZAS discussion paper on the website of the 'skeptics' group, the New Zealand Climate Science Coalition, of which he was a co-founder [124].

As mentioned above, global warming was one of the 'scary issues' covered in the Association's 2008 Survey of New Zealand scientists and technologists. In this, an overwhelming number of respondents 'placed themselves squarely in the camp of the orthodox interpretation of global warming being a consequence of human activities …' (69.5%) [125]. The 2007/08 NZAS President, Dr Kate McGrath, in her first President's column in *New Zealand Science Review* after the 2008 General Election, urged New Zealand's political leaders to lead internationally in 'ensuring environmental sustainability – including, but not limited to climate change – in a broader framework than carbon credits and carbon footprints toted up by accountants and controlled by lawyers' [126]. Her successor as President, Dr James Renwick, a lead author for IPCC Working Group I and later a member of the prestigious Joint Scientific Committee of the World Climate Research Programme [127], was reported in *New Zealand Science Review* as being one of a group of leading climate scientists who welcomed a Judge's decision to throw out a 'bizarre' Court case brought by the above-mentioned 'skeptics' challenging the climate work of the National Institute of Water and Atmospheric Research [128].

In 2015, NZAS President, Dr Nicola Gaston, released a statement criticising the government's hasty and inadequate consultation about climate change prior to the 2015 UN Climate Change Conference of parties to the Kyoto Protocol, held in Paris. She had only been able to make a brief submission on behalf of NZAS to the Ministry for the Environment because of the short time frame and lack of expert information provided [129]. The Government commitment to reduce greenhouse gas emissions to 30 per cent below 2005 levels by 2030 was confirmed [130] when the new international climate change agreement was signed in Paris in December 2015.

Continuing concerns

Sexism in science

In a 2015 White Paper, entitled 'Enabling Women's Potential', the New Zealand National Council of Women asserted that New Zealand has 'a sexist culture and stereotypes that negatively impact on all genders' and backed it up with statistics, while also making recommendations for change [131].

With respect to science, the Association of Women in the Sciences (AWIS), which had been formed after a 1985 conference involving NZAS Council [132], was established *inter alia* 'to provide visibility for women in the sciences and to support women to achieve visibility in the sciences' [133]. In 1993, NZAS 1991/92 Vice-President Dr Jean Fleming was the contact for the AWIS Suffrage Centennial Science Conference, which gave a considerable boost to the profile of women in science [134]. However, by the turn of the century, it was concluded in a *New Zealand Science Review* report about another AWIS conference [135] that 'prejudices against women as scientists and barriers to women progressing in science do still exist'. The Guest Editorial in the same issue provided confirmatory statistics on gender inequalities and speculated about possible causes [136].

Although the term 'sexism' had been coined as far back as the 1960s, euphemisms have commonly been used to prevaricate about the situation, and spurious science has been generated to defend the status quo - which is actually sexist, as shown at the most recent AWIS conference by NZAS 2014/15 President Nicola Gaston. Dr Gaston presented a review of scientific research showing the several ways that sexism is manifested in science, often even by those scientists who consider themselves objective [137]. She has expanded on this topic in a book, 'Why Science is Sexist', in which she has suggested that sexism in science is a disease and proposed that science should be used to treat the symptoms [138].

Career development and stability

Career stability has been a concern of NZAS from the outset in the major restructurings of the 1990s. With the passage of time, the situation improved, and in the NZAS 2008 Survey of Scientists, on average 60.9% of respondents agreed that their job was reasonably secure [139], with a higher percentage in the under-35 age group, who had, of course, entered the system some years after it had become stabilised.

Nevertheless, redundancies from CRIs continued to occur as programmes changed under changing funding priorities, notably with Industrial Research Ltd being subsumed into the very different culture of Callaghan Innovation [140] and continuing restructurings occurring with AgResearch [141,142].

Moreover, 'The malleable, responsive scientific culture proposed by MORST also seems unlikely to provide opportunities for the maturation of young scientists or the accumulation of skills and expertise needed to resolve scientific problems efficiently' as reported by NZAS 1996/97 President Dr Brion Jarvis from a 1997 RSNZ conference on 'Science and Technology: The human dimension'. [143]. The nature of research has been changing, as pointed out by NZAS 2011/12 President Shaun Hendy, the tackling of complex problems requiring 'specialised skills, many acquired post-PhD' [144].

The commencement of New Zealand Science and Technology Postdoctoral Fellowships in 1993 as part of FRST's funding responsibilities had passed almost unnoticed at the time, but by 2008, the Minister of Science, Dr Pete Hodgson, confirmed the need for support for early-career researchers [145]. However, the next government terminated them in favour of the rather different Rutherford Discovery Fellowships

Distinguished Professor David Penny was made an Honorary Member of NZAS in 2013. He was President of the Association in 1989//91, and contributed to the original comprehensive NZAS Survey of Scientists. He received the NZAS Marsden Medal in 2000, the Royal Society of New Zealand Rutherford Medal in 2004, and was made CNZM in 2006.

[146]. A strong protest letter to the Minister of Science and Innovation, the Prime Minister's Chief Science Advisor, and the Chief Executives of the Ministry and RSNZ, signed by 560 PhDs, was posted on the NZAS website [147]. In response, MORST moved to bring forward their review of postdoctoral fellowships, but with its demise, followed by absorption of the Ministry of Science and Innovation (MSI) into the Ministry of Business, Innovation and Employment (MBIE) in 2012, this was never implemented [MSI, Dec 2011, unpublished introduction to 'Review of Rutherford Discovery Fellowships']. At this point it became apparent that MBIE had no knowledge of how many scientists were employed as postdocs and that the policy and some of the new Minister's statements were based on grossly incorrect estimates.

The NZAS 2012 conference 'Do emerging scientists have a future?' highlighted the problem [148], showing that universities here (as well as in the USA) were producing more PhDs than there were positions available, creating a 'postdoctoral void'. The positive outcome of this conference according to NZAS 2012/13 President Shaun Hendy was the formation of networks such as Stratus in Auckland [149] and the Wellington Early- and Mid-Career Researchers group [150]. NZAS was able to provide some small financial assistance to these groups [unpublished minutes, 19/11/2013, 19/11/2014]. In Australia, the inaugural meeting of the Early/Mid Career Forum confronted their similar problem of job insecurity for young researchers [151].

One of the NZAS criticisms of the 2015 National Statement of Science Investment was that 'postdoc' does not appear there, nor is career stability and the funding of large infrastructure adequately addressed [152].

Secrecy and ethics

In moves reminiscent of the 1970s [153], NZAS has had to increasingly defend the right and responsibility of scientists to speak freely on issues of public concern in which they have expertise. An 'unfortunate side of science restructuring' in 1992 was 'the pressure on [NZAS] Council Members from their employers not to speak out on issues' [154]. At the same time, the Minister of Science suggested that NZAS might consider holding a conference on science ethics, and RSNZ indicated that 'a major project for the year is a review of ethical standards in science' [155]. NZAS subsequently recorded that 'recruiting new members to [NZAS] Council from within the CRIs had been problematical' partly because of 'pressures making it difficult to speak out on science policy issues that may be perceived to be in conflict with the interests of their employing organisations' [156].

In the 1996 Survey of Scientists, only 23 per cent of scientists in CRIs, but 67 per cent of those in universities agreed that they were able to speak freely on public policy issues where they had expertise 'without fear of reprisals from management'; however, by the 2008 NZAS Survey the level able to speak 'without prior approval from my employer' remained at 23 per cent in CRIs but had fallen to 30 per cent in universities [157].

All the while, too, NZAS Council stated that scientists were being given less of a voice in official policy making, as 'active scientists have been essentially excluded from policy development, advisory committees and governing boards' while 'Government science managers have increasing control of science but little understanding of science' [158].

In an online survey by NZAS in 2014, 39.8 per cent of those responding said they had been kept from making public comment on controversial issues by their employer's policy or for fear of losing funding [159] As explained there, a suggestion in the MBIE Science in Society report, *A Nation of Curious Minds*, that science in New Zealand is in need of a 'code for public engagement' raised concerns that this would prevent scientists from speaking out against government policy and actions, but there was a counter-view that the current RSNZ Code of Professional Standards and Ethics was sufficient to cover ethical behaviour by scientists. In its submission on the National Statement of Science Investment, NZAS had recommended that the boards of CRIs should be required to support the RSNZ Code and any of their scientists who spoke out in accordance with that code. In universities, too, there were concerns that funding pressures prevented scientists from fulfilling their statutory role as 'critic and conscience'.

The 2015 NZAS Conference addressed the theme of 'Going public: scientists speaking out on difficult issues'. In her Presidential address, Dr Nicola Gaston spoke of 'empowering informed voices' and asserted that good communication should be based, like science itself, on teamwork, rather than the concept of the individual 'honest broker'[160].

A book by NZAS 2011–13 President, Dr Shaun Hendy, cites cases of business and government undermining scientists and trying to 'muzzle' them, and shows the risks that this might entail for the public. He suggests the need for a truly independent Parliamentary Commissioner for Science 'to forge a new relationship between scientists, policy-makers and the public' and 'ensure that our science is never silenced' [161].

Communication

New Zealand Science Review has been a principal avenue for communicating the Association's activities although it has consumed a major part of its finances, and in many years survived only by reducing the number of issues and total number of pages per year [162]. By the early 2000s it was occasionally eating into reserves, and a promotional campaign to increase membership and subscribers was accompanied by a new stylish look. Following the death of Dr Brian Shorland in 1999, temporary editors produced the journal until Dr Ira Beu was appointed as honorary editor in 2000. She was responsible for the welcomed change of appearance and content, but resigned after 18 months. She was succeeded by the current editor, Dr Allen Petrey, who retained the outer appearance but arranged for a necessarily more economical format and brought it back to a regular schedule of four issues per year apart from the occasional double issue to keep the journal in budget [163]. The transfer of the Silver Jubilee Trust Fund to the General Fund in 2003/04 also helped; it had never been used for any of the purposes envisaged at its

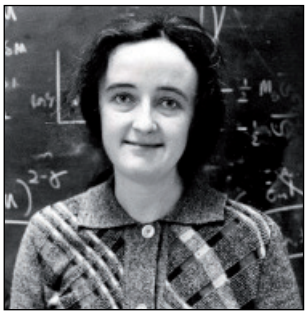
establishment [164]. The Association's annual conferences later began to show a surplus, which helped to put the overall finances on a firm footing [unpublished minute 15/11/2012].

During the late 1980s when frequency of publication had been reduced, NZAS had started a news sheet, *SciNet*, [165] and this contained news of some of the Association's activities, but it petered out after the October 1994 issue, which had contained many of the results of the 1994 Survey of Scientists, subsequently covered in full in *New Zealand Science Review* [see above]. In 1999, NZAS Council decided to have a regular column in the two-monthly commercial newsletter, *New Zealand Laboratory News,* as a way of communicating beyond its membership [166], and several members of Council contributed articles about the Association's affairs, notably NZAS 2000/02 President Dr Mike Berridge with articles about genetic modification, in which he commented that 'Never before has so much time and so many resources been spent investigating a single scientific issue in such depth' [167]. Unfortunately this arrangement ceased in late 2002.

In 1998 a website had been established under the auspices of RSNZ [168]. It was used to publicise the Association's activities and press releases, and as a contact point for the Association's awards. It was rebuilt as a separate website (ww.scientists.org.nz) in 2010 [169] and has become well used by the media. Issues of New Zealand Science Review from 2002 onwards are accessible there and have been regularly uploaded immediately after hardcopy publication; there is open access [unpublished minutes 03/11/2009], although, for financial reasons, the possibility of some form of limitation is under discussion [unpublished minutes 14/10/2015]. The journal was picked up by Google in 2011. Many of the back issues from about volume 6 have been scanned on the HathiTrust Digital Library [https://babel.hathitrust.org/cgi/ls?field1=ocr;q1=New%20Zealand%20Science%20Review;a=srchls;lmt=ft;pn=1] and were given open access by NZAS; Council would like to have all back issues online [unpublished minutes 19/11/2014].

In an attempt to foster communication of science, the Association had created a Science Journalism Award in 1980, but this became increasingly difficult to award, as the pool of science journalists in New Zealand dwindled with pressures placed on conventional media with the rise of electronic media; when sponsors withdrew, it was discontinued in 2001 [170]. A Science Communicator Award for practising scientists for excellence in communicating science to the general public had been started in 1990, and with different sponsors has continued to be successful. A full list of all medal recipients is given on the NZAS website, which also gives biographies of recipients after 1997 (Research and Marsden Medals) and 1999 (Communication and Shorland Medals). The awards presentation ceremonies have been popular; they helped to raise the Association's public profile and, with the appropriate Minister usually being asked to make the presentations, opened a chink of political dialogue. Having Ministers, government heads, and the Prime Minister's Chief Science Advisor speak at NZAS conferences has also been conducive to dialogue, which has otherwise diminished.

With the spectacular growth of social media, particularly Facebook and Twitter (both founded in 2006), communication has been transformed. NZAS opened both Facebook and Twitter (#nzscientists) accounts and also provided a blogging facility on its website. Recent NZAS conferences have received numerous tweets, and by 2012 the Twitter account had over



Professor Beatrice Hill Tinsley (1941-1981), a distinguished New Zealand astronomer, whose research made fundamental contributions to the understanding of how galaxies evolve, grow and die. The NZAS Research Medal has recently been renamed in her honour.

300 followers, including media people [unpublished minutes 15/11/2012]. NZAS 2011/13 President Shaun Hendy has been an advocate for increased use of social media [171] and listed several scientists with blog sites.

The website enabled NZAS to conduct a survey in 2014 on members' experiences with the National Science Challenges in order to represent their views in response to the Minister's saying he had received no comments [172]. Subsequently NZAS conducted the above-mentioned internet survey of scientists about the RSNZ Code of Public Engagement [ibid], and this received numerous comments on Facebook, which helped the Association frame its submission.

All of this has been followed by news media, who have come to look on NZAS as the 'go-to' place for comment on science and science policy issues [unpublished minutes 14/11/2015].

A way forward

The NZAS 75th Anniversary Conference appropriately dealt with using the lessons from the past to chart a way forward, working towards achieving 'a supportive environment for the next generation of leading scientists to grow and evolve in [173].

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Appendix 1. New Zealand Association of Scientists Officers 1991–2016.

Year	President	Vice-President	Secretary	Treasurer
1991/92	A. Kirton	J Fleming	M Berridge	L Ryan
1992/93	A. Kirton	–	M Berridge	L Ryan
1993/94	–	C Sissons	M Berridge	L Ryan
1994/95	C Sissons	–	M Berridge	L Ryan
1995/96	C Sissons	–	M Berridge	L Ryan
1996/97	B Jarvis	–	M Berridge	L Ryan
1997/98	B Jarvis	J Bradford-Grieve	M Berridge	L Ryan
1998/99	J Bradford-Grieve	D Day	M Berridge	L Ryan
1999/2000	J Bradford-Grieve	D Day	M Berridge	L Ryan
2000/01	M Berridge	–	P Davis, F McDonald	L Ryan
2001/02	M Berridge	–	P Davis, F McDonald	L Ryan
2002/03	E Smith	–	B Jarvis, F McDonald	L Ryan
2003/04	E Smith	–	F McDonald	L Ryan
2004/05	H Campbell	D Lillis	F McDonald	L Ryan
2005/06	H Campbell	D Lillis	F McDonald	J Grieve
2006/07	D Lillis	K McGrath	F McDonald	J Grieve
2007/08	K McGrath	–	F McDonald	J Grieve
2008/09	K McGrath	J Renwick	F McDonald	P Gandar
2009/10	J Renwick	–	F McDonald	P Gandar
2010/11	J Renwick	–	F McDonald	P Gandar
2011/12	S Hendy	–	F McDonald	P Gandar
2012/13	S Hendy	D Frame	F McDonald	P Gandar
2013/14	N Gaston	–	F McDonald	P Gandar
2014/15	N Gaston	–	F McDonald	P Gandar
2015/16	C Stevens	–	F McDonald	C Bumby