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Cawthron Institute
science and meth contamination
science and policy
experiments and conservation
Association Awards for 2018

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

Editor: Allen Petrey
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Contents

Cover: 'Fellworth', Cawthron Institute's home in Nelson [Image: Easterfield, 1933, facing p. 4].

Instructions to Authors

New Zealand Science Review provides a forum for the discussion of science policy. It also covers science education, science planning, and freedom of information. It is aimed at scientists, decision makers, and the interested public. Readability and absence of jargon are essential.

Manuscripts on the above topics are welcome, and should be emailed to the editor (editor@scientists.org.nz).

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

Full manuscripts (with author's name removed) will be sent for peer review, 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.

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 high-definition passport-size photograph of themselves. This will be published with the article.

Articles may be submitted in MS Office Word, rich text format, or plain text. Diagrams and photographs should be on separate files (preferably eps, tif, jpg, 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. However, colour may be used if the author or the author's institute is willing to pay for the added cost.

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 authors cited at the end. Alternative systems may be acceptable provided that they are used accurately and consistently.

In this issue

In this issue, Peter Hodder, from HodderBalog Social and Scientific Research, gives us a fascinating account of the history of the management of science in New Zealand, set against the background of the development of DSIR in the 1920s and the science reforms of the 1980s–1990s. The Cawthron Institute in Nelson is used as a case study in this account.

In her article *Science and evidence informing policymaking in New Zealand: The meth contamination story*, University of Auckland's Anne Bardsley provides a brief overview of the complex story that led to the report produced during Peter Gluckman's tenure as the Prime Minister's Chief Science Advisor – 'Methamphetamine contamination in residential properties: Exposures, risk levels, and interpretation of standards' (Gluckman *et al*. 2018*). Release of the report rapidly shifted policies across a number of government agencies and abruptly curtailed the predatory practices of an industry which had flourished because of a particular failure in the science-to-policy exchange: no one had asked the right question. Dr Bardsley's paper is based on her presentation at the Association's 2018 Annual Conference in Auckland.

From *The Conversation* we carry an article from Bangor University's Julia Patricia Jones, *More experiments may help explore what works in conservation,* in which she indicates that there is growing awareness that conservationists have not always done a good enough job at evaluating whether the things they do really work. She suggests that more high-quality evaluations (which won't always be experiments) are certainly needed and only by learning from current practice can the future effectiveness of conservation be improved.

Also in this issue are the New Zealand Association of Scientists *Co-Presidents' Report for 2017/18*, the Association's Awards for 2018 and the results of election of Officers and Council Members for 2018/19 held at the AGM in Auckland in November. Congratulations to the medal winners and the newly elected Councillors.

Allen Petrey
Editor

* Gluckman, P.D., Bardsley, A., Low, F. 2018. *Methamphetamine Contamination in Residential Properties: Exposures, risk levels, and interpretation of standards.* Office of the Prime Minister's Chief Science Advisor, Auckland.

President's column

This is my last column as Co-President of the Association, a role I've shared with (now President) Dr Heide Friedrich for the last year. It's been a continuing learning experience for me personally, and it's been energising working with Council members and a crew of people passionate about making the most of science for the nation.

Many of the issues that the Association has explored over the last decade remain at the forefront of nurturing our science ecosystem. Career development and the postdoctoral squeeze remains a challenge. I do get the sense though, that now at least this issue is recognised by all sides as being real, and that solutions are needed so that our science ecosystem can flourish. The reality that science does not operate in a vacuum is the same as it ever was. Diversity and equity remain a challenge. While great strides are being made in terms of gender and cultural equity, it is clear that there is so much more to do. I accept that I come from a position of privilege on this, and I'm grateful for the guidance from colleagues. The tension apparently implicit in maintaining a balance between science and fiscal responsibility in research and academic institutes continues, and we are promoting the need for more senior scientists to seek board appointments to aid in maintaining this balance. Open access to science and scientific opinion remains a challenge, both in New Zealand and internationally.

On this last point – relating to the ability for scientists to be able to speak out – we've made a mistake. The challenge of providing the best possible evidence to membership and readers stays with us and can raise some complex situations. Last year we highlighted the need for discourse on science in the media to focus on the science and not people. This was especially in connection with media at the time relating to the health of our freshwater systems and the impacts some farming practices were having and a public dialogue between Dr Doug Edmeades and Dr Mike Joy (then of Massey University, now at Victoria University of Wellington). We did this through a letter to the Association's membership[1]. In the aftermath of this I suggested to Dr Edmeades that, if he felt his ideas were being misrepresented he should write an article on the science and get it peer-reviewed. While the position of President of the Association doesn't have any particular influence on the journal, I suggested the *New Zealand Science Review* would be one place that he could submit the work. Dr Edmeades did write an article and, while it was reviewed, it was published as correspondence[2].

The Association's Council has considered the contents of the letter and does not find a basis for its claims and wishes to make it clear that it does not reflect the views of the Association. Dr Joy responds in this issue[3] and the Editor is drawing a line under the issue.

This is leading us to reconsider aspects of the Association's journal, the *New Zealand Science Review*, as there are changing models for such tools and a growing diversity of places where opinions can be aired, given that there is an expectation that we all respect ethical constraints such as those outlined in the Royal Society Te Apārangi Code of Conduct[4]. What will continue is that the journal, largely through the valiant efforts of its editorial team, will be a place to publish peer-reviewed articles on NZ-focused science and science policy, science education, science planning, and freedom of information. It provides a unique source of information to the community, building on its legacy over the past seven decades, now and in the future.

As this column was being written, the Minister for Science and Innovation, the Hon. Megan Woods, announced the continued funding of the National Science Challenges. It is very encouraging to hear that support for mission-led science is continuing. However, the report on the first phase of the funding is not being released. We are left with the likely situation that we will be given very little information to evaluate the success of one of the largest experiments in New Zealand science funding undertaken in recent times. This is untenable, but perhaps not surprising as it reflects a national attitude towards opacity in funding decisions. The reason most often given is that disclosing reviews will propagate litigation from disgruntled scientists. Maybe, but this points the finger at scientists. What about The Process and the reviews? I think we need to make the decisions guiding our science funding far more transparent – and this extends beyond the National Science Challenges.

One initiative I intend to stay involved with is fostering a version of 'Science Meets Parliament' that suits the New Zealand science ecosystem. This concept, developed in Australia over the last two decades, seeks to come up with new pathways between scientists and politicians and decision-makers. It has also just been taken up in Canada with a recent event in Ottawa. To be clear, the idea is not about facilitating lobbying, but about building links and enhancing awareness of each other's perspectives. I took great pleasure in presenting the early plans at the recent 2018 NZAS annual conference in Auckland. The Association is in discussion with the Royal Society Te Apārangi, the Prime Minister's Chief Science Advisor, Universities New Zealand, Science New Zealand, and the Research and Education Advanced Network New Zealand (REANNZ) in order to seek funds to proceed with a pilot event.

I'd like to thank Associate Professor Nicola Gaston for having invited me to take on the role of President, and for the Council in supporting me, which was a leap of faith at the time. In turn, Dr Heide Friedrich has embraced the role and is bringing a unique flavour as she has set about refreshing the team and processes. Thanks everyone.

Craig Stevens
Co-President

[1] Subsequently published as NZSR (2017), vol. 74(2): 46 – Correspondence.

[2] NZSR (2017), vol. 74(2): 47–49 – Correspondence.

[3] Correspondence – this issue, page 21.

[4] Royal Society Te Apārangi Code of Professional Standards and Ethics – https://royalsociety.org.nz/who-we-are/our-rules-and-codes/consultation-on-new-code-of-professional-standards-and-ethics/

Article

Independent scientific research entities in New Zealand: Cawthron Institute as a case study

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The Cawthron Institute in Nelson is used as a case study in the history of the management of science in New Zealand, set against the background of the development of DSIR in the 1920s and the science reforms of the 1980s–1990s. The early scientific and managerial successes of the Cawthron scientific research institute enabled it to build relationships with DSIR, while still remaining committed to the application of the research undertaken to its region. The latter commitment has endured, and so the Institute is able to occupy the middle ground between the 'industrial science' of the Crown research institutes and the 'academic' science of universities, as do some individual scientists as contractors.

Keywords: Cawthron Institute, research, T.H. Easterfield, DSIR, CRIs, science funding

Introduction

The history of science in New Zealand is generally described from the perspective of the 'institutions' of science established by provincial governments (e.g. Otago's Geological Survey) and central government (in particular the Geological Survey and the Colonial Laboratory – see Fig. 1), and the New Zealand Institute, which as well as being a forum for the oral dissemination of research at its meetings, exerted a peer review function in the publication of research. Initial research efforts were oriented to the discovery of the 'new' land's flora and fauna and the understanding of its geology, and were generally undertaken by gentleman scholars with the time and/or financial resources that could be devoted to such pursuits. However, not all would-be researchers found employment with government agencies or their associated bodies, and had to struggle to survive while carving out a scientific career (e.g. Hyde 2016, 2017).

As the actual and potential economic value of the nation's resources became apparent, description of flora, fauna, rocks, minerals and water needed to be complemented by testing and analysis of samples, for which equipment and staff skilled in its use was necessary. In addition, as colonial society became established, manufacturing and the supply of consumer goods brought its own challenges, requiring testing and analysis, to ensure foods were unadulterated and goods were of reasonable quality. In addition there were a few independent laboratories in some larger communities, e.g. that of the chemist William Grayling (Wood 2016), who contracted their services to the Laboratory. A few independent botanists and geologists / conchologists (e.g., Henry Suter: Hyde 2017; Margaret Mestayer: Hayward 2012, Hayward & Morley 2011) also contracted their services – and sometimes donated their 'finds' – to the Colonial Museum or regional geological surveys.

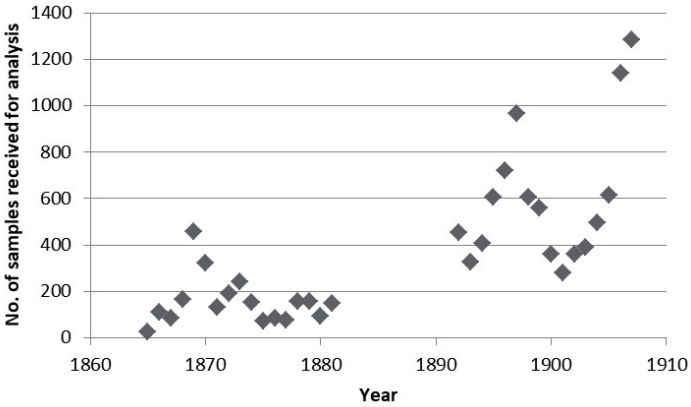

Figure 1. Number of samples sent to the Colonial Laboratory for analysis, 1865–1881, 1892–1907 (Compiled from 'Records of Samples Books' 24994, Archives New Zealand)

In comparison, the privately endowed and operated Cawthron Institute, established in Nelson, was – and has remained – research-focused, and has outlasted Government research institutions with which it has competed and within which it could have been subsumed. From 25 staff-members in 1970, the Institute has grown to more than 220 in 2018 (Reflections…, 2018). This article explores possible reasons for the Institute's

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survival independent from the tentacles of the expansionist Department of Scientific and Industrial Research (DSIR), and from the Crown research institutes into which DSIR's research divisions ultimately morphed.

Establishment and early development of the Cawthron Institute

The Cawthron Institute was established in 1920 in Nelson (New Zealand) as a result of the Supreme Court approving the recommendations made by the trustees of the estate of Thomas Cawthron 'who bequeathed practically the whole of his estate valued at £240,000 for the establishment of a Technical Institute and Museum' upon his death in 1915 (*Silver Jubilee of Cawthron Institute* 1945). The recommendations were formulated for the trustees by a commission (Table 1) comprising five eminent scientists of the time who spanned the disciplines of science and were drawn from across the country, under the chairmanship of Sir James Wilson.

The Commission's report, prepared by Professor Easterfield proposed 'That the chief scope of the work of the Institute should be instruction in and performance of scientific research…. Such research to be definitely related to the industries of Nelson, and of the Dominion', noting 'That inasmuch as agriculture is and is likely to remain for many years the most important industry both of Nelson and of the Dominion, the research work should in the first instance bear chiefly upon this industry and in particular upon fruitgrowing' (Miller 1963: 81).

Although the Commission's report was parochial, it was not myopic in its view of research, adding 'That provision should … be made, as funds permit, for systematic research on other subjects, e.g. the chemistry, physics and biology of the soils, the development of forest lands, including re-afforestation, the utilisation of clays and other minerals, the fish industry and such other subjects as may from time to time be deemed important and worthy of study' (Miller 1963: 82). As discussed later, this potential diversity of research matched well with that which was subsequently both proposed and implemented by the government research agency – the Department of Scientific and Research – in the late 1920s.

Little appears to have been made of the Commission's recommendation that the Institute should have an educational function, viz. 'It would be an Industrial and Technical School in the true sense of the word, *teaching* [italics added] effectively the application of science to our national industries', possibly because it is overshadowed by that particular recommendation's closing sentence which makes a plea for *research* funding. Had teaching been provided in an 'industrial and technical school' within the Institute as recommended, it would certainly have aligned at least with Easterfield's own largely New Zealand-oriented applied research activities undertaken while at Victoria University College (Halton 2012, p. 152-153), shown in Figure 2.

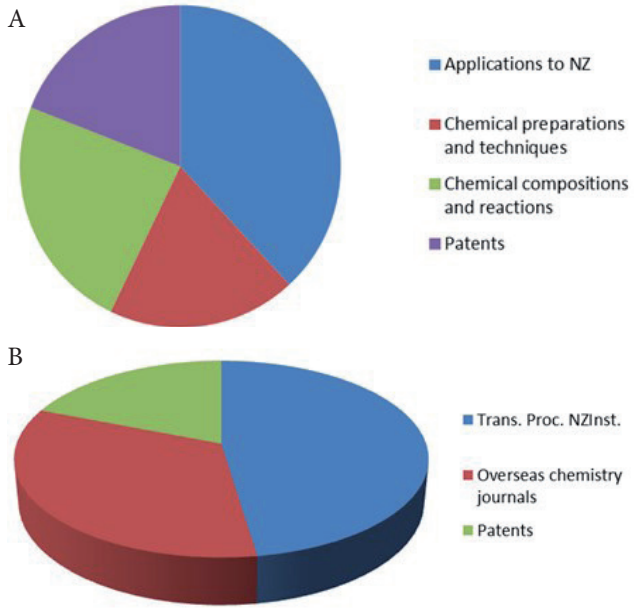

Figure 2. Distribution of the 21 research outputs of Professor T.H. Easterfield, while at Victoria University College, 1900–1915.

A: by topic – applied chemistry, 'pure' chemistry and patents.

B: by type of publication – ***Transactions and Proceedings of the New Zealand Institute*****, overseas chemistry journals, patents.**

Curiously, had a site for Victoria University College not been found in Wellington, Easterfield might have been a chemistry professor of a Nelson-based educational institute. A footnote to the history of the Cawthron Institute (Miller 1963: 95) refers to a resolution carried by the colony's Legislative Council in 1900 that 'failing the choice of a site in Wellington, the Victoria College Act be amended to enable a site being selected in Nelson', as reported in the *Colonist* newspaper (*Colonist*, 29 September 1900). This proposal 'led to a lively controversy' before it was rescinded (*Colonist*, 10 October 1900). It is possible to imagine the distinctive first building of Victoria College (Figure 3A) being built on one of the hills surrounding Nelson – perhaps those same hills that were considered as sites for a proposed solar observatory to be funded by Cawthron (Proctor 1914), or possibly his own preference, Britannia Heights. Equally possible is that the conversion of space in 'Fellworth' (Figure 3B), the house initially purchased as the headquarters of the Cawthron Institute, could have accommodated university teaching laboratories similar to those portrayed for chemistry teaching at Victoria University College (Figure 3C).

Easterfield was offered the appointment as the first director of the Cawthron Institute in October 1919, and accepted it the following month, albeit with 'diffidence' (Easterfield, 1933). His appointment is unsurprising, given his authorship of the Commission's report and his undoubted commitment to research. This commitment was articulated in his Victoria University

Table 1. Members of the Commission to advise the trustees of the Cawthron estate.

Commission member	Discipline	Role	Location
Chair: Sir James Wilson	Agriculture	President of the Board of Agriculture	Bulls (Manawatu)
Professor T.H. Easterfield	Chemistry	Professor of Chemistry (and Physics until 1909)	Victoria University College, Wellington
Professor W.B. Benham	Biology	Professor of Biology	Otago University, Dunedin
Professor F.P. Worley	Chemistry	Professor of Chemistry	Auckland University College, Auckland
Dr P. Marshall	Geology	Professor of Geology and Mineralogy	Otago University, Dunedin
Dr L. Cockayne	Botany	Independent researcher	Wellington

Figure 3. What might have been.

A (left): The original building for Victoria College (Victoria University College after 1914) on the Kelburn hillside overlooking Wellington city, 1918 [Image: Alexander Turnbull Library, Ref.: 1/4-023178-G].

B (centre): 'Fellworth', Cawthron Institute's home in Nelson [Image: Easterfield, 1933, facing p. 4].

C (right): 'Victoria College: First Chemistry Laboratory 1901' by Sybil Johnson – a watercolour of the laboratory in the Wellington Technical College, Victoria Street [Image: https://teara.govt.nz/en/artwork/43356/victoria-colleges-first-chemistry-laboratory-1901].

College inaugural lecture (1899): 'Research as the prime factor in a scientific education' (Easterfield 1949). Barrowman (1999: 16) noted that in this lecture Easterfield 'argued for early specialization by students, research and original investigation as a significant component of undergraduate work and the "absolute necessity" of a "really good laboratory"'. At Victoria, Easterfield is said to have 'inspired a group of young research students, most notably his eventual successor, P.W. Robertson', and while at Cawthron he similarly 'trained and inspired a group of scientists, one of whom succeeded him when he retired from the directorship in 1933' (Davis 1996).

Consistent with the Commission's recommendations, Easterfield oversaw the Institute's research development in three main areas: (a) agriculture and chemistry, (b) mycology, and (c) entomology (Rigg 1945). Figure 4 shows that for the first 25 years of the Institute's existence research in these three themes was – at least initially – Nelson-centric. Even in later years, these themes remained dominated by research considered to be relevant to New Zealand.

From the outset, the Institute sought and obtained financial support from the primary industries which benefited directly from its research, the Department of Agriculture and Britain's Empire Marketing Board. This approach to funding pre-empted the development of the research associations established years later under the auspices of the Department of Scientific and Industrial Research.

With his applied research interests, it is interesting to speculate that had Easterfield stayed at Victoria University College and had Sir Robert Stout achieved his vision of linking university scientific research with that of Government to form a single 'large scientific university in Wellington', the organisation of scientific research in New Zealand could have been very different, resembling the idea that Stout (1920) advocated:

> *… a large scientific institute or University college situated in Wellington that could have done all the research work and technical work required by the various Government Departments , and which at the same time should have been a teaching institution. Some aid could have been got from students doing research work when they were not engaged in their studies during the University session, and the whole of the scientific*

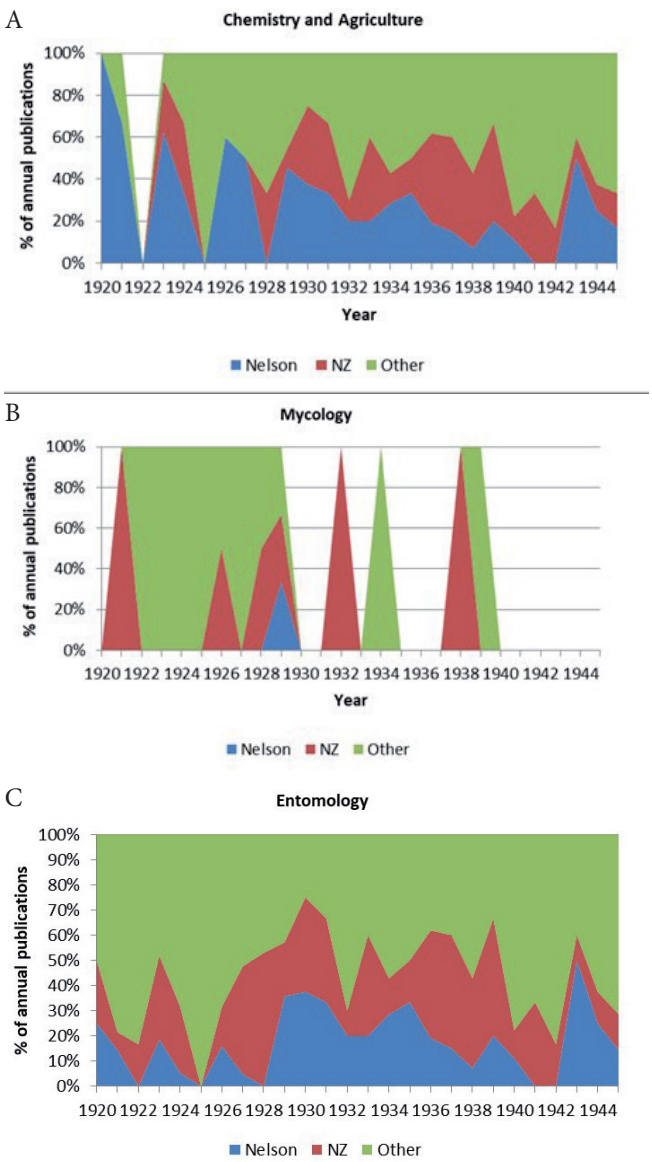

Figure 4. Variation of publications of the Cawthron Institute whose titles indicate application to Nelson or New Zealand, for the three initial research themes of the Institute, 1920–1945 (compiled from Rigg 1945, pp. 38–50). A: Chemistry and Agriculture; B: Mycology; C: Entomology.

work of the colony [sic] could have been more co-ordinated than it is now.… The establishment of such an institution would not interfere with scientific work for University colleges, but it would be an economical gain to the Government were there one large Science University in Wellington…

This idea was explored with reference to the Cawthron Institute in an editorial of the then recently established *NZ Journal of Science and Technology* (Anon 1920) noting that:

… the Cawthron Trustees do not regard the bequest as a local affair. Though the home of the Institute will be in Nelson, its interests will be nation-wide. They consider that the whole Dominion and the Empire should benefit by the researches carried out in the Institute and the principles established there. They recognise also that there is no line of demarcation between pure and applied science, and that the pursuit of the two should go hand in hand if results of great economic value are to be obtained.

The editorial also drew attention to the possibility that bequests and donations from other sources could be used for buildings and also new scientific departments, scholarships and fellowships, and endowments for the library and museum.

Cawthron Institute and the embryonic DSIR

The focus on applied research by Cawthron staff, the Institute's modest success in attracting funding from primary industry interests (Miller 1963: 64–87) and the co-operation with existing government scientific agencies – in particular, the Department of Agriculture (Table 2), should have resonated with Sir Frank Heath, the proponent of the establishment of a new government agency (largely mirroring Britain's Department of Scientific and Industrial Research), the purpose of which was 'to co-ordinate and support research carried out in existing institutes or in new research associations formed in co-operation with particular industries' (Galbreath 1998: 18).

Heath's visit to New Zealand in early 1926 involved his looking at current research activities and, through discussion with leaders of primary and secondary industries, assessing future research needs. As part of Heath's extensive itinerary throughout New Zealand, he visited Nelson and the Cawthron Institute (Figure 5A).

Of the visit, the *Evening Post* (23 February 1926) reported, 'He [Sir Frank Heath] was deeply impressed with the work being done by the Cawthron Institute. New Zealand was getting its "full whack" out of that institute. The work done on woolly aphis alone was worthwhile. It is a very good example of what sound scientific research can do.' This suggests that Heath had been made aware of the six research publications relating to woolly aphis written by the Institute's Chief Biologist and Entomologist, R.J. Tillyard, between 1921 and 1925, described subsequently in Noyes & Valentine (1989). The newspaper reported that Heath had said of the Institute, 'It is a fine place with a fine staff. I would like to see it twice as strong….' Despite the Cawthron Institute making a favourable impression on Heath, his report did not advocate any change in the institute's standing or role, either

A

B

Figure 5. Exploring a new direction for New Zealand's scientific research. A (top): Sir Frank Heath (at left) with Sir Thomas Easterfield (Director of the Cawthron Institute), February 1926 [Image: Alexander Turnbull Library, Ref.: PA Coll-5584-50]; B (below): The Assistant Director of Education, Dr Ernest Marsden (at left) who accompanied Sir Frank Heath (at right) and Lady Heath on the North Island part of their New Zealand tour [Image: *Auckland Star*, 5 February 1926].

Table 2. Co-operation between Cawthron Institute and Department of Agriculture staff prior to DSIR's founding in 1926.*

Cawthron Institute*		Department of Agriculture†	
Research theme	Key staff	Key staff	Research theme
Soils and agriculture	Theodore Rigg (assisted by M.W. Young and E.J. Champteloup)	B.C. Aston A.H. Cockayne J.A. Gilruth	Soils Pastures Veterinary
Mycology	Dr Kathleen Curtis	G.H. Cunningham T.W. Kirk	Mycology Fruit
Entomology	R.J. Tillyard (assisted by A.Philpott and D.D. Milligan)	D Miller‡	Entomology

* 1920 staff listed in *Silver Jubilee of the Cawthron Institute 1920–1945*, 29 October 1945, p. 11.

† Compiled from text in Miller 1963: 96.

‡ Miller subsequently became the Director of DSIR's Entomology Division, as well as holding a role at Cawthron (see text).

regionally or nationally. Rather, he envisaged that the existing Dominion Laboratory was to be the nucleus of a department to advise the Government and manufacturers on various problems connected with industry and to form a centre for the special scientific investigations required.

Media commentators seem not to have noticed that the two government officials who accompanied Heath on his tour of New Zealand fared well in the administrative structure proposed by Heath and subsequently agreed to by the Government: the then Assistant Director of Education Dr Ernest Marsden (who accompanied Heath in the North Island, see Figure 5B), was appointed as the first Permanent Secretary of the Department of Scientific and Industrial Research; and Dr J.S. Maclaurin (who accompanied Heath in the South Island) was already the Director of the Dominion Laboratory, which was to be the 'nucleus' of the new department.

Heath's report also identified the need for an agricultural college in a dairying region, which would ultimately be established on the outskirts of Palmerston North. If it had not been for the insistent requirement for the proposed college to service the dairying industry, the Cawthron Institute might have been a good choice for an agricultural college, given the range of research into primary production already carried out there, and the diversity of soil types in its surrounding countryside (Figure 6). Moreover, such a college would have realised the educational aspirations of the Institute's founders.

Incidentally, Cawthron's being a national science research institute was not the only opportunity for national prominence that Nelson was denied: Nelson could have been New Zealand's capital city. Given the intense parochialism in colonial New Zealand, moving the capital city from Auckland to a location closer to the country's geographic centre was never going to be an easy decision (Brett 2016: 158–159). The matter was resolved in 1863 by accepting the recommendation of an independent commission which after consideration of six 'capabilities' (accessibility, water – specifically harbour, land, resources, defence, and natural disadvantages) decided on Wellington rather than Nelson (*AJHR* 1864).

Although Easterfield was not a member of the Cawthron Institute Trust Board, his thinking and ideas were clearly well matched to the Board's aspirations, as is apparent by his writing the Commission's report. In effect, his and the Trust Board's entrepreneurial orientation appear to have been well matched (Miller & Breton-Miller 2011), although whether that orientation extended to an ambition for the Cawthron to be a national research institution is less clear. Certainly Easterfield's successor as director Theodore (later Sir Theodore) Rigg – who had initiated the Waimea County Soil Survey (see Figure 6) – appears not to have had any such ambition, perhaps because of the precarious nature of research funding through the Depression years, but perhaps also because of an inferred 'demand for security and resources limited their EO [entrepreneurial orientation] and constrained performance', considered to be a likely occurrence in small public entities (Miller & Breton-Miller 2011).

Cawthron's Theodore Rigg was invited by DSIR in 1930 to direct its survey of the North Island soils derived from volcanic ash (now often referred to as 'tephra'). DSIR staff conducted the field surveys while the analytical work was undertaken by E.B. Kidson 'who was seconded to the [Cawthron] Institute to assist in the analyses of the countless soil samples' (Miller 1963:

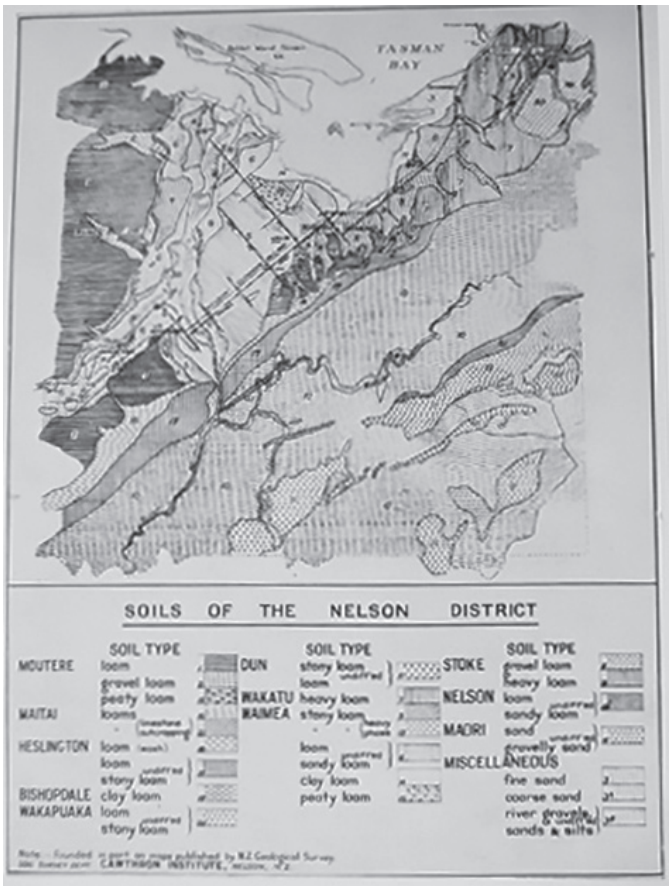

Figure 6. The Cawthron Institute undertook the first systematic soil survey in New Zealand, from which a soil map of the Waimea Plains was drawn. The map identified 23 different soil types and reflects the complexity of the underlying geology [Image: Rigg, 1945, facing page 4].

118). A reason for Cawthron undertaking this work may have been because of the few changes that had been made to the Dominion Laboratory's facilities during the 1930s, and because of the Laboratory's prime commitment to meeting the needs of other Government departments (Hughson & Ellis 1981: 66, 70–78). However, Cawthron's involvement had the unexpected advantage of enabling the recognition of the similarity of the 'bush-sickness' associated with animals grazing the tephra-derived soils of the North Island to the animal sickness noticed at Glenhope in Nelson and Morton Mains in Southland, areas with which the scientists at Cawthron were already familiar (Rigg & Askew 1936a, 1936b), and which led to the identification of cobalt as the elemental deficiency in all these soils (Askew & Dixon 1936, Dixon 1936). Much later the economic benefits of the research carried out into bush sickness was lauded by Clare (1999) as having been 'huge', and the most commonly cited justification of the expenditure of public funds on research.

Of these developments Miller (1963: 119) comments, 'So it came about that the initial surveys carried out by Rigg in Nelson, together with those of the Research Department under his direction elsewhere, fathered the national soil service.' Rigg's 'fathering' would seem to have provided an opportunity for the Cawthron to become a national research organisation, particularly once, as Robertson (1998) observes, he had become

> *… a leading figure in all aspects of agricultural research. He became head of the Department of Agriculture and Chemistry in 1924 and assistant director in 1928, and in 1933 (on the*

retirement of Easterfield) director of the Cawthron Institute. In the early 1930s he was director of the soil reconnaissance survey of the central North Island, and from the mid 1930s he was for nine years officer for the Soil Survey Division in charge of chemical work for the DSIR. He [Rigg] was a founding member of the Council of Scientific and Industrial Research from 1926 to 1954, and became its chairman from 1943. From 1926 he was associated with the foundation and administration of many committees of the council, as well as other organisations concerned with science in agriculture. He was a member of the Nelson Catchment Board from its inception in 1944 and chairman from 1950 to 1956, a member of the New Zealand Advisory Section of the Nuffield Foundation (1946–58), and chairman of the Farm Committee. On two major trips overseas he attended delegations representing New Zealand: in 1927, at an international soil conference in Washington DC, and in 1946 at the Imperial Agricultural Bureaux Conference, London.

Helen Hughes, the daughter of Theodore Rigg, noted that a former staff member considered that her father 'missed an opportunity to build an empire while he had influence as Chair of the Scientific Research Council; instead, he let DSIR establish the Appleby Research Station, and the Tobacco and Hop Research Stations' (Hughes 2005: 74). However, she countered this somewhat in the next paragraph by saying: 'However, a former DSIR scientist, who as a young man took notes at Council meetings, recalls my father picking up work for Cawthron at every available opportunity. Although Cawthron did not own the Research Stations, nevertheless they carried out a great deal of analytical and mycological work for them.' Hughes considered that Rigg 'built up an excellent *esprit de corps* among the staff of the Institute which enabled the joint attack which so many problems at that time required if success in their solution and adaptation into practice was to be attained'. With such a small staff, the esprit de corps referred to by Hughes may have given Cawthron something of the atmosphere of a 'family firm', for which collaboration with other research entities appears to have been considered by Rigg to be more desirable than either competition with DSIR or amalgamation with that entity.

Rigg retired from the directorship in 1956, and subsequently married the Institute's long-time leader of mycology research – Dr Kathleen Curtis (Royal Society of NZ 2017a), who had retired in 1952. Had this marriage occurred earlier, this might have imbued the Institute with even more of the character of a 'family firm', which recent research into management culture might have been seen as beneficial (Mehrotra *et al.* 2011). Rigg's successor as director from 1956 – David Miller – does not appear to have harboured expansionist ambitions for the Institute either, Miller (1963: 98) commenting:

A natural outcome in the progress of any healthy institution engaged in several fields of research is that certain phases of the work tend to assume a magnitude too great for an institution – especially one of limited resources – to carry further, and they become functions of major specialized organisations engaged on such phases. So it has been with the Cawthron Institute, which originally tilled many fields and developed certain phases of agricultural research to a stage where they were taken over as branches of the Department of Scientific and Industrial Research. As a result of that, the Institute, no longer standing alone but retaining the autonomy of a privately

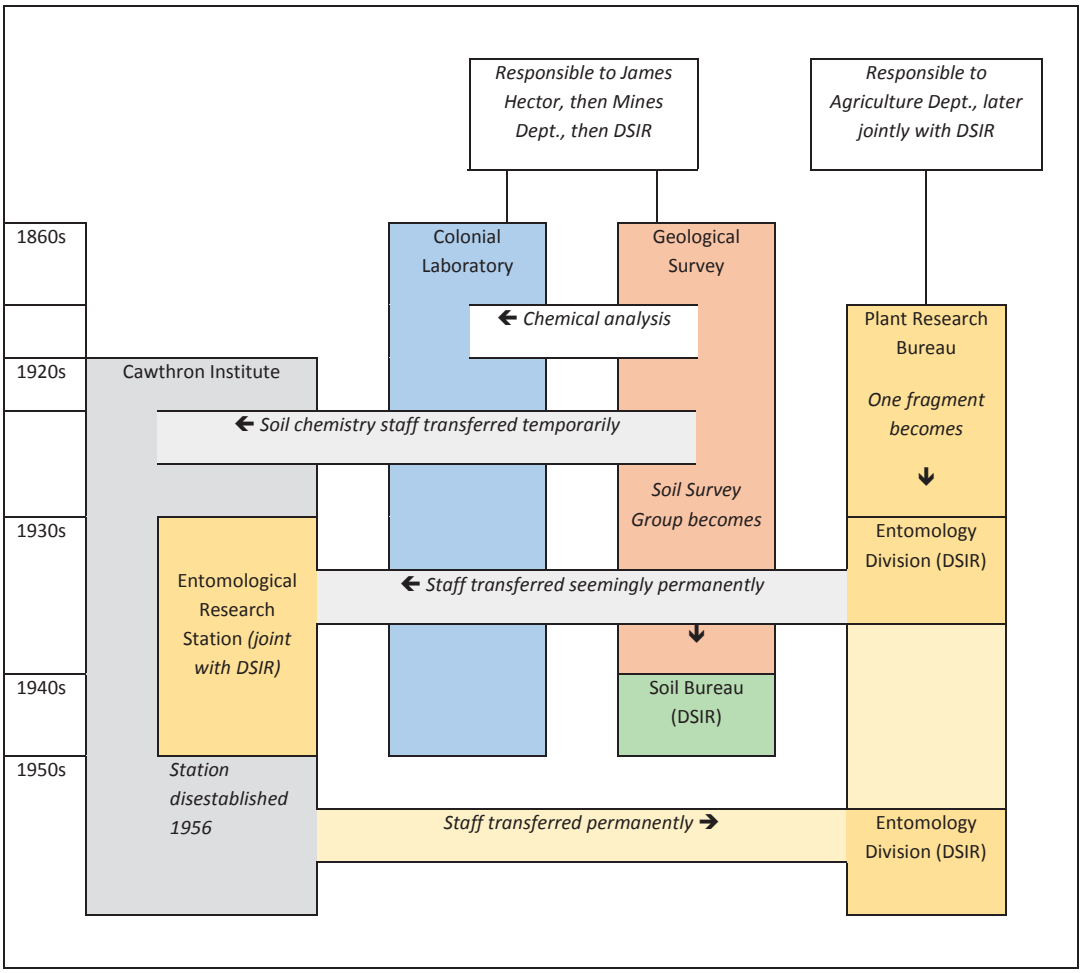

Figure 7. 'Comings and goings': linkages between Cawthron Institute and Government research agencies.

endowed institution, has become a part within the overall framework of agricultural research in New Zealand. To meet that changing scene, the Institute entered a new era and was reorganized during 1956 to 1959 to deal mainly with problems of plant and animal nutrition in the Nelson district.

This re-organisation – which by today's terminology would probably be considered a 'return to core business' if not an outright retrenchment – was undertaken during Miller's directorship of the Institute from 1956 to 1959 (he having served more than the previous two decades as Assistant Director). The sentiments Miller expresses in the paragraph above also need to be assessed in the context of his own appointments: during the time Miller was Assistant Director of the Cawthron Institute and was its Chief Entomologist he headed – from 1949 – a joint DSIR–Cawthron Nelson-based entity known as the Entomological Research Station. When Miller was appointed as Cawthron's director in 1956, Entomology Division was separated from Cawthron as a 'regular' division of DSIR (Galbreath 1998: 238). Although Miller may not have envisaged such a possibility, Entomology Division was transferred in 1973 to Mount Albert in Auckland to rejoin Plant Diseases Division from which it had separated in 1936 (Galbreath 1998: 101–102, 258), and a decades-long association between the Cawthron Institute and various divisions of DSIR effectively came to an end (Figure 7, *see* p. 8).

In an approach akin to that which purports to bring human activity into the ambit of science (Watson 2016: 452), Miller's (1963) history of the Cawthron Institute to the early 1960s can be represented as the 'anticipation', 'dream' and 'frustration' stages that characterise many works of fiction (Table 3), particularly the 'Rags to Riches' type of plot (Booker 2004: 563–566). However, the ultimate 'riches' – a prominent national role for the research institute, which may have been envisaged by Cawthron, and possibly by Easterfield – are unlikely ever to be achieved, despite the dissolution of DSIR providing the tantalising prospect of such a role.

Coping with competition

The 1980s were turbulent times for New Zealand: the initiation of an 'open economy' and reliance on the 'market' to determine the provision and cost of services was far-reaching, and led to the 'dismantling of DSIR', and the subsequent rearrangement of some of its research divisions into new entities in 1990 and later – in 1992 – re-forming them as parts of several new entities: the quaintly named thematically focused Crown research institutes (CRIs) listed in Table 4 (Galbreath 1998: 256–264). Some of these Institutes also included the research entities of other government departments (e.g. that within the Department of Agriculture which became AgResearch) and agencies (e.g. NWASCO – National Water and Soil Conservation Organisation, which became part of NIWA). Not all CRIs survived: an early casualty was the Institute for Social Research and Development; and the years since 1992 have seen a reduction in their number from ten to seven, as well as some repurposing and rebranding.

The formation of these Institutes occurred with significant redundancy of scientific and support staff. As noted by Pockley (1996):

… many scientists have been disillusioned by the impact of a thirty percent decline in government funding [of science] since 1981… A survey of the 300 members of the Association [New Zealand Association of Scientists] in the academic community, government and industry found that the scientific workforce had been 'traumatised and decimated' and its productivity 'greatly reduced'.

That disillusionment would be a consequence of the reforms is readily apparent when a comparison is made between 'academic science' (undertaken by universities), 'state science' (undertaken by DSIR) and 'industrial science' (undertaken by CRIs and research associations), as described by Charlesworth *et al* (1989: 223–224) and shown in Table 5.

Table 3. Interpretation of events in the history of the Cawthron Institute with the stages of fictional plots.

Fictional Plot ⬇	Stage ❶	Stage ❷	Stage ❸	Stage ❹	Stage ❺
Overcoming the monster	Anticipation and 'call'	Dream	Frustration	Nightmare	Thrilling escape and death of monster
The quest	The call	The journey	Arrival and frustration	The final ordeals	The goal
Voyage and return	Anticipation and 'fall' into other world	Initial fascination or dream	Frustration	Nightmare (survival threatened)	Thrilling escape and return
Comedy	Shadows of confusion, uncertainty and frustration		Confusion and darkness, leading to a nightmarish tangle		Shadows dispelled, miraculous transformation; reunion
Tragedy	Anticipation	Dream	Frustration	Nightmare	Destruction
Rebirth	Hero or heroine under shadow of dark power	All goes reason-ably well, threat may recede	Threat returns, hero or heroine imprisoned in living death	'living death' continues; dark power seems to have triumphed	'miraculous redemption' or Sense of self-fulfillment
Rags to riches	*Initial wretchedness 'The Call"*	*Out in the world, initial success*	*Central crisis*	*Independence and the final ordeal*	*Final union, completion and fulfilment*
History ⬇					
Cawthron Institute	*Establishment and report of Commission to trustees*	*Initial success, under Easterfield's directorship*	*Success, but over-shadowed by DSIR's establishment and growth*	*Uncertainty associated with changes to research environment*	*Adjustment to changed research environment*

Table 4. The fate of DSIR's divisions: their distribution across the Crown research institutes.*

Field of research*	Crown research institutes†							Other‡		
	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Antarctic Research									❶	
Applied Biochemistry	●					●				
Applied Mathematics										
Botany				●						
Chemistry		●	●					●		
Crop Research						●				
Ecology				●						
Entomology	●			●		●				
Geology and Geophysics			●							
Grasslands	●									
Horticulture and processing						●				
Industrial Development *and* Industrial Processing								●		
Information and Publishing										❶
Meteorology									❷	
Nuclear Sciences			●							
Physics and Engineering								●		
Plant Diseases	●			●		●				
Plant Physiology						●				
Soil Sciences				●						
Water Sciences					●					

*These 'fields' from Galbreath (1998: 256–264) were often the names of the DSIR divisions.

† As at 2018, Crown research institutes (CRIs) are: 1, AgResearch; 2, Institute of Environmental Research (ESR); 3, Institute of Geological and Nuclear Sciences (GNS Science); 4, Landcare Research; 5, National Institute of Water and Atmospheric Research (NIWA); 6, Plant and Food Research; 7, Scion (formerly Forest Research Institute). Forestry research was never part of DSIR, the Forest Research Institute being associated with the NZ Forest Service, itself a component of a succession of ministries and departments until its reconstitution as a CRI.

‡ Other research entities: 8, Callaghan Innovation, a Crown entity which includes a former CRI, viz. Industrial Research Ltd.; 9, Government ministries, departments and agencies: ❶, Initially associated with Ministry of External Relations and Trade, but currently a government agency – NZ Antarctic Research Institute/Antarctica NZ; ❷, Civil Aviation Authority; 10, Non-governmental organisations: ❶, Royal Society of NZ.

Table 5. Some characteristics of 'academic', 'state' and 'industrial' science in New Zealand.

	Academic science	**State science**	**Industrial science**
NZ examples	Universities	DSIR	Research associations, CRIs
Goals	Scientists have freedom to choose their own research projects	Industry goals overlap with traditional goals of academic science	Goals dominated by employer and industry
Functional arrangement	Disciplinary	Largely disciplinary	Goal-directed: often inter- or multidisciplinary
Staff feelings of 'comfort'	High: performance consistent with training	Modest: performance requirements based on training	Low: performance not in accord with the ideals of the discipline in which scientists were trained
Overall system	A collegial system of disciplinary associations, characterised by a commitment to the production of the best possible knowledge as judged by scientific peers	Goal of producing disciplinary scientific knowledge is carried out alongside and may be subordinate to medical, social, or industrial goals	Emphasis on team research to meet medical, social, industrial, or environmental goals

The – albeit variable – interaction of the former DSIR with the Cawthron Institute was effectively halted by the reforms, potentially leaving the Cawthron Institute as a minor player in the resulting competitive research environment. Cawthron was effectively sandwiched between individual scientists operating as sole-traders or small companies and the larger institutions – principally the CRIs (Whitley 1984), all of which appeared to have intruded into the 'industrial space' – see Figure 8. In fact, the Cawthron Institute has become focused on environmental research and on supporting sustainable development in dairying, seafood, and aquaculture. These are industries and activities of increasing importance to the Nelson–Tasman region, and therefore a fitting link to Cawthron's heritage (see also Table 9).

Some of those scientists made redundant responded to Masood's (1997) challenge: 'Do you aim for traditional posts at academic institutions, look for the relatively lucrative pastures of the private sector, or even beat a path into the world of entrepreneurship?' by establishing scientific or technological consul-

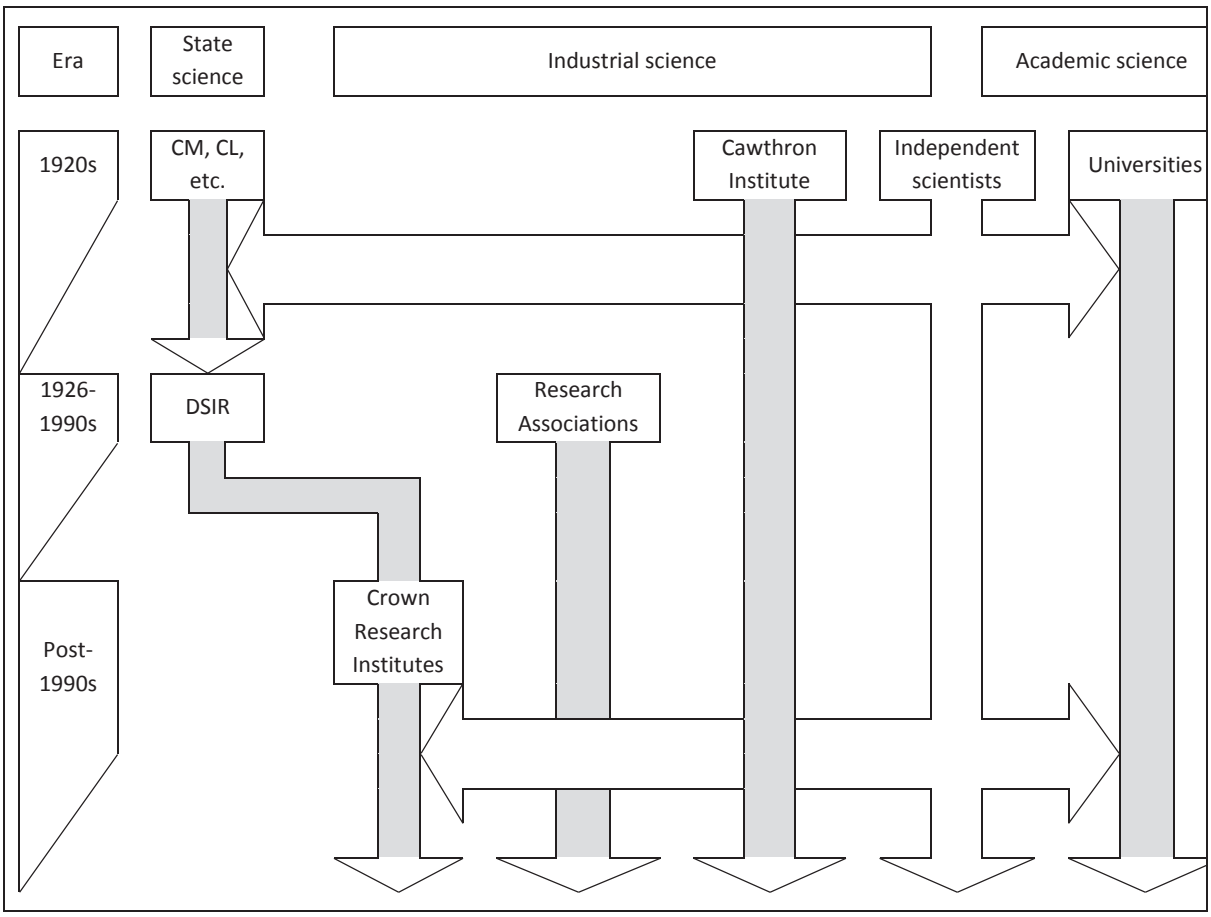

Figure 8. Changes in the organisation of New Zealand science from the 1920s to post-1990s. In colonial times, some independent scientists contracted to universities and state science institutions, especially the Colonial Laboratory (CL), the Colonial Museum (CM) and regional museums, and their associated geological surveys. From the 1990s, independent scientists contracted their services to universities or the CRIs, although some remain independent, seeking funding through other agencies, on occasion including the Marsden Fund.

tancies. These businesses typically operated as sole traders or small companies, sometimes providing scientific services to the CRI into which their former employer had morphed. Lacking the resources generally available to companies formed as commercial spin-offs from universities (Ho *et al.* 2010), businesses of this type that have survived are likely to have remained small.

Table 6 shows that of members of the New Zealand Institute of Chemistry who responded to salary surveys (Boston & van Eyk 2001; Summerfield 2006; Nicholson 2016), the proportion of those privately or self-employed reached a peak in 2006 (39%), and has reduced thereafter, while the proportion of those in the public sector has declined slightly. This suggests that the reforms of the 1990s have permanently changed the structure of the chemical sciences workforce. This inference is probably applicable to other sciences as well.

Despite the rhetoric at the time of the reforms, there appears little evidence that government services (including scientific research) were delivered with greater effectiveness or efficiency as a result of the reforms (Galbreath 1998: 254–255). Rather more likely, the changes are a corporate version of what Booker (2004: 580) describes as an

> *…alternation of illusion and disillusion [that] typifies the pattern of political life even in a peaceful democracy [like New Zealand]. Almost every successful political leader has a 'shelf life', whereby initially he or she commands respect and seems to represent the qualities the country needs. But eventually*

Table 6. Employment sector of respondents to NZ Institute of Chemistry salary surveys in 2000, 2006 and 2016.

2000		2006		2016	
Employment sector	***%***	***Employment sector***	***%***	***Employment sector***	***%***
Education	45%	University Secondary school	33% 6%	University School Polytechnic	42% 9% 1%
Public	20%	Crown Research Institute Central & Local Govt	19% 3%	Crown Research Institute Government agency	12% 6%
Private	35%	Private employee Owner / Director	29% 10%	Private company Self-employed	26% 2%
Other	0.4%	Other	9%	Other	2%

the very qualities which once seemed so admirable show their shadowy underside and come to viewed as discreditable. The same kind of switch into its opposite applies to the popularity of political parties. A party may successfully hold sway for a long period, but eventually it seems tired, no longer capable of governing effectively or in touch with the social forces which put it in power. This helps generate a sense of optimism that the party which is its main rival can provide a new government which is quite different: energetic, efficient, honest, more in tune with the country's needs. Its election to power is hailed as marking the start of a new, more hopeful era. For a while the new reforming government may enjoy a 'Dream' stage [see Table 3], when it seems it can do no wrong. But it gradually moves into a Frustration stage, when its errors and deficiencies seem to multiply. Finally, as the mood of the country shifts irreversibly against it, it enters a Nightmare stage where it can do nothing right; and by now, of course, the familiar momentum of optimism is building up around its opponents until the moment when they can sweep into power. Thus does the cycle of illusion and disillusion begin again.

Biennial reports of Research and Development in New Zealand compiled during the 2000s (*Research and Development in New Zealand* 2002, 2004, 2006, 2008, 2010, 2012) indicate a slow increase in the number of people employed in science (Figure 9), but remaining at about 1% of the workforce. Expenditure on research and development also increased modestly, slightly increasing as a proportion of gross domestic product (1.15% in 2002, rising to 1.27% by 2012).

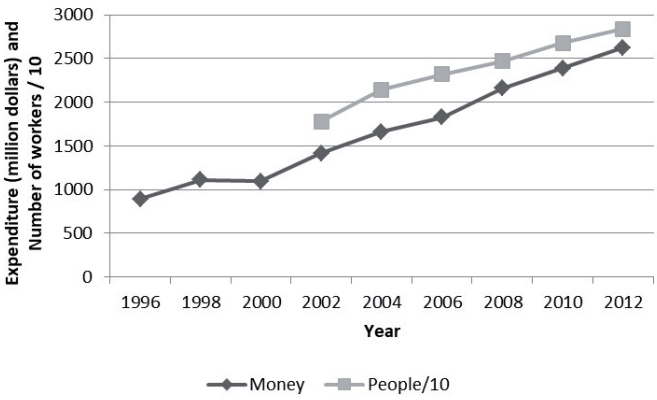

Figure 9. Research in the millennium decade – I. Modest increases in expenditure and personnel (being the sum of researchers, including student researchers from 2006), technicians and support staff.

The most significant change is in the proportion of expenditure on applied research, which has increased slightly over the period 2002–2012 at the expense of experimental and basic research (Figure 10). This trend is consistent with the applied focus of the missions of CRI research, and the likelihood that independent researchers or small companies do not have the facilities and resources to undertake basic and experimental research.

This protracted reform of the organisation of New Zealand's government science establishments transformed 'state science' into 'industrial science', in which the CRIs had to bid for funds, unlike the research associations whose funding relied on industry levies, was described by Galbreath (1998: 264–265) as:

The system of 'research associations' undertaking research for particular industries, and jointly funded by the industry and

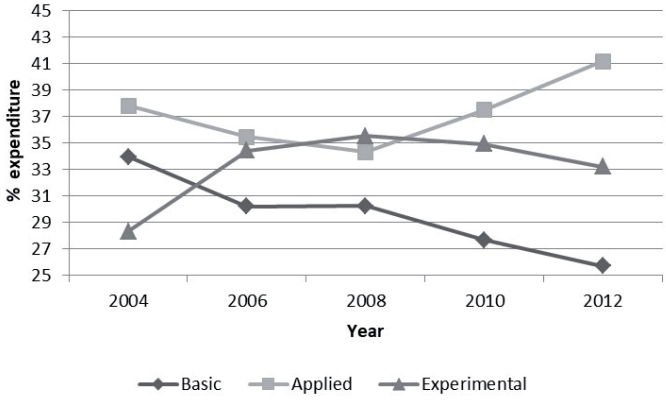

Figure 10. Research in the millennium decade – II. Changes in the proportion of expenditure on basic, applied and experimental research.

government (through DSIR), was based on the system developed in Britain from 1915. After the establishment of DSIR in New Zealand in 1926, a series of research associations were established in association with it. Most of them, although small, survived declining government grants and outlasted DSIR itself.

The current reality of this changed research environment is apparent in an analysis of the recipients of grants from the Marsden Fund (Royal Society of NZ 2017b) through which the Cawthron Institute received two grants each of $300,000: in 2014 ('Adaptive evolution in changing environments: can epigenetic variation compensate for low genetic diversity?'), and in 2016 ('Blooming buddies: explaining the co-existence of toxic and non-toxic strains in algal blooms'). Although Crown research institutes, smaller independent research organisations (e.g. Cawthron), and individual researchers do also seek and receive grants, the Marsden Fund clearly favours universities in terms of the number of projects supported (Table 7) and the amount of funds awarded (Table 8).

The situation is complicated slightly by the inclusion of independent researchers and those in other organisations as 'associate investigators' in projects for which the principal researchers ('principal investigators') are typically employees of universities or Crown research institutes. However, it is apparent that of the CRIs, GNS Science and NIWA dominate; and that CRIs dominate independent organisations / researchers: projects from the latter represent 14% of the combined number of CRI and independent projects (Table 7), and 12% of the funding (Table 8).

A counter-suggestion to this capture of most externally funded research by a small number of institutional 'players' is that the more recently developed National Science Challenges (MBIE 2016) would enhance the prospects of collaboration between CRIs themselves and between CRIs, universities and other researchers. Penman and Goldson (2015) supported this, indicating that this would provide for 'a balance of science excellence, effective boards, creating best teams free of institutional constraints, a focus on delivering outcomes and benefits, sharing of data and infrastructure, and engaging with wider society'. However, this optimistic suggestion of how the National Science Challenges might work has not eventuated. Table 9 shows a concentration of challenges in the universities, especially the University of Otago (with seven collaborations); and in two CRIs, viz. Geological and Nuclear Science, and Scion

Table 7. Research grants from Marsden Fund, 2012–2017: Annual number of projects supported.

Recipients	Number of projects supported						
	2012	*2013*	*2014*	*2015*	*2016*	*2017*	*All*
Universities / Wananga							
Auckland University of Technology	1	-	-	1	-	-	2
Lincoln University	-	-	-	-	1	-	1
Massey University	8	7	11	9	7	26	68
Te Wananga o Raukawa	-	-	-	-	-	1	1
University of Auckland	21	34	29	28	38	31	181
University of Canterbury	5	11	6	5	7	11	45
University of Otago	22	22	22	18	23	32	139
University of Waikato	6	3	4	4	5	4	26
Victoria University of Wellington	12	21	24	13	26	17	113
All participating universities / wananga	*75*	*98*	*96*	*78*	*107*	*122*	*576*
Crown Research Institutes							
AgResearch	-	1	-	-	-	-	1
GNS Science	5	4	1	4	-	2	16
Industrial Research Limited / Callaghan	2	1	-	-	2	-	5
Institute for Environmental Science & Research	-	-	-	-	1	-	1
Landcare Research	1	1	-	1	1	3	7
NIWA	2	1	-	1	3	4	11
Plant and Food Research	-	2	-	3	-	1	6
Scion [Forest research]	-	-	1	-	-	-	1
All participating Crown Research Institutes	*10*	*10*	*2*	*9*	*7*	*10*	*48*
Independent institutions / researchers*							
Bodeker Science	-	-	1	-	-	-	1
Canterbury Museum					1	-	1
Cawthron Institute	-	-	1	-	1	-	2
Dragonfly Science	-	-	1	-	-	-	1
Malaghan Institute for Medical Research*	-	-	-	1	-	-	1
MOTU [Economics research]	1	-	-	1	-	-	2
All participating independent science institutions / researchers	*1*	*0*	*3*	*2*	*2*	*0*	*8*

*The Malaghan Institute for Medical Research, which was awarded a research grant in 2015, subcontracts to one of the organisations in this table, and may be a partner in future applications to the Marsden Fund. Medical research receives significant funding from the Health Research Council. The Malaghan Institute, the Medical Research Institute of New Zealand, and three Maori health research independent research organisations have all received significant funding from this source since 2014.

(each with four collaborations). Collaboration is skewed towards a small number of institutional 'players'; or as Aref *et al* (2018) express it, *'Constructing a collaboration network of institutions, we observe a power-law distribution indicating that a small number of New Zealand institutions account for a large proportion of national collaborations.'*

Although the staff numbers of Table 9 can only be considered indicative, Figure 11A suggests that involvement in these collaborations appears to favour larger institutions. However, a maximum in the polynomial line of best fit (Figure 11B) suggests that there may be an optimum size of an institution that participates in such challenges.

Conclusion

The history of Nelson's Cawthron Institute started with the realisation of a colonist's vision for science in his home-region of New Zealand, and the establishment of a private research establishment through the concordance of the initial Cawthron vision with chemistry professor T.H. Easterfield's pragmatism. Over the ensuing years the Institute formed and lost relationships with bigger players but survived. In light of the current dominance of science research by large organisations (i.e. the Crown research institutes that supplanted DSIR, the government entity Callaghan Innovation; and the universities), Cawthron can still 'hold its own' with the larger players. Cawthron may even inspire smaller research organisations and independent researchers to continue to participate in scientific research in New Zealand.

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Table 8. Research grants from Marsden Fund, 2012–2017: Annual funds distributed.

Recipients	Annual funds distributed ($000)						
	2012	*2013*	*2014*	*2015*	*2016*	*2017*	*All*
Universities / Wananga							
Auckland University of Technology	345	0	0	670	0	0	1015
Lincoln University	0	0	0	0	300	0	300
Massey University	5585	2987	6176	5230	3105	15627	38710
Te Wananga o Raukawa	0	0	0	0	0	845	845
University of Auckland	13435	16268	15985	16619	20630	19752	102689
University of Canterbury	1935	5511	3655	3812	4900	6375	26188
University of Otago	14190	13024	13908	11153	13735	20615	86625
University of Waikato	3605	2265	2420	1310	3035	2712	15347
Victoria University of Wellington	6750	11230	10822	8045	14350	9256	60453
All participating universities / wananga	*45845*	*51285*	*52966*	*46839*	*60055*	*75182*	*332172*
Crown research institutes							
AgResearch	0	826	0	0	0	0	826
GNS Science	4120	2099	695	2575	600	600	10689
Industrial Research Limited / Callaghan	690	695	0	0	0	0	1385
Institute for Environmental Science & Research	0	0	0	0	830	0	830
Landcare Research	920	300	0	300	830	2150	4500
NIWA	1300	739	0	300	2020	2358	6717
Plant and Food Research	0	1504	0	1440	0	895	3839
Scion	0	0	300	0	0	0	300
All participating Crown Research Institutes	*7030*	*6163*	*995*	*4615*	*4280*	*6003*	*29086*
Independent institutions / researchers							
Bodeker Science	0	0	785	0	0	0	785
Canterbury Museum	0	0	0	0	300	0	300
Cawthron Institute	0	0	300	0	300	0	600
Dragonfly Science	0	0	300	0	0	0	300
Malaghan Institute for Medical Research	0	0	0	840	0	0	840
MOTU	890	0	0	300	0	0	1190
All participating independent institutions / researchers	*890*	*0*	*1385*	*1140*	*600*	*0*	*4015*

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Table 9. Institutional participation in New Zealand's National Science Challenges.

Collaboration partners		Staff†	National Science Challenges*							Σ‡
			1	*2*	*3*	*4*	*5*	*6*	*7*	
Universities ❶										
U1	Auckland University of Technology	1183		●			●			2
U2	Lincoln University	200		●	●	●	●			4
U3	Massey University	1339	●	●	●	●	●			5
U4	University of Auckland	2232		●	●	●	●	●		5
U5	University of Canterbury	749		●		●	●	●		4
U6	University of Otago	1552	●	●	●	●	●	●	●	7
U7	University of Waikato	599		●	●		●	●		4
U8	Victoria University of Wellington	1062		●		●	●	●	●	5
Crown research institutes ❷										
C1	AgResearch	700	●	●			●			3
C2	Institute of Environmental Science and Research	400		●	●		●			3
C3	Institute of Geological and Nuclear Sciences	332		●	●			●	●	4
C4	Landcare Research	283			●				●	2
C5	National Institute of Water and Atmospheric Science	454		●	●	●				3
C6	Plant and Food Research	675	●	●	●					3
C7	Scion [Timber-related research]	321		●	●	●	●			4
Government agency ❸										
G1	Antarctica New Zealand	36							●	1
Independent institutions ❹										
I1	Building Research Association of NZ	100				●				1
I2	Cawthron Institute	220						●		1
I3	Lincoln Agritech	59			●		●			2
I4	Opus International Consultants	23				●				1
No. of collaboration partners in each challenge			4	14	12	10	12	7	5	

*National Science Challenges: ***1***, High-value nutrition; ***2***, New Zealand's biological heritage; ***3***, Our land and water; ***4***, Resilience to nature's challenges; ***5***, Science for technological innovation; ***6***, Sustainable seas; ***7***, The Deep South.

† Estimated from information available in annual reports or websites; the distribution of staff across academic, professional, administrative are not consistent between organisations. If only the total staff number is listed, it is assumed for the purposes of Figure 11 that half are involved in research. For universities the number of all academic staff reported in annual reports is halved for the purposes of Figure 11, on the basis of there being a 50:50 split between teaching and research commitments of academic staff. Where specified, technical are included but administrative staff are excluded.

‡ Σ is total number of challenges in which collaboration partner participates.

❶ For universities: U1, https://www.aut.ac.nz/__data/assets/pdf_file/0007/119815/diversity-infographic-page-v6.pdf ; U2, http://www.lincoln.ac.nz/Documents/Marketing/Publications/Annual-Reports/AnnualReport2017.pdf ("Academic 200 (31%)" of 643 FTE); U3, https://www.massey.ac.nz/massey/fms/About%20Massey/University-Management/documents/annual-report/massey-university-annual-report-2017.pdf?ED32BC3335191A5A35230F1A1D93401B (2017); U4, https://cdn.auckland.ac.nz/assets/auckland/about-us/the-university/official-publications/annual-report/2017-annual-report-university-of-auckland.pdf (2017); U5, https://www.canterbury.ac.nz/media/documents/annual-reports/Annual-Report-2017-Full.pdf (2017); U6, https://www.otago.ac.nz/about/official-documents/otago684398.pdf (2017); ….. U7, https://www.waikato.ac.nz/annualreport/ (2017); U8, https://www.victoria.ac.nz/__data/assets/pdf_file/0008/756008/2017-annual-report.pdf ("teaching and research staff" in 2017).

❷ For Crown Research Institutes: C1: https://www.agresearch.co.nz/assets/Uploads/AgResearch-Annual-Report-2018-for-web.pdf includes "scientists, technicians and farm support staff"; C2: https://www.esr.cri.nz/home/about-esr/ ('expert minds'); C3, https://www.gns.cri.nz/Home/About-Us/Corporate-Documents/Annual-Reports/2018-Annual-Report ("Over 85% of our staff [> 390] are directly involved in science"); C4, https://www.landcareresearch.co.nz/about/people/science-teams ; C5, https://www.niwa.co.nz/about/our-people (590 staff; annual report indicates 76.9% are scientists or technicians); www.niwa.co.nz/static/web/NIWA13387_2018-Annual-Report_13LR_Web.pdf); C6, https://www.plantandfood.co.nz/page/our-people/ ("We have over 900 people, 75% of who are working in our science operations teams"); C7, https://www.scionresearch.com/__data/assets/pdf_file/0007/64924/Scion_2018_AR_PartA.pdf ("includes fixed-term, student and postdoctoral staff").

❸For the Government agency: G1, http://www.antarcticanz.govt.nz/about-us/our-people/

❹For independent institutions: I1, https://www.branz.co.nz/cms_display.php?sn=401&st=1; I2, https://www.cawthron.org.nz/analytical-services/news/2018; I3, https://www.lincolnagritech.co.nz/about/our-team/; I4, https://www.wsp-opus.co.nz/assets/Uploads/PDFS/Opus-Research/2016-Opus-Research-Booklet-march.pdf (probably excludes technicians)

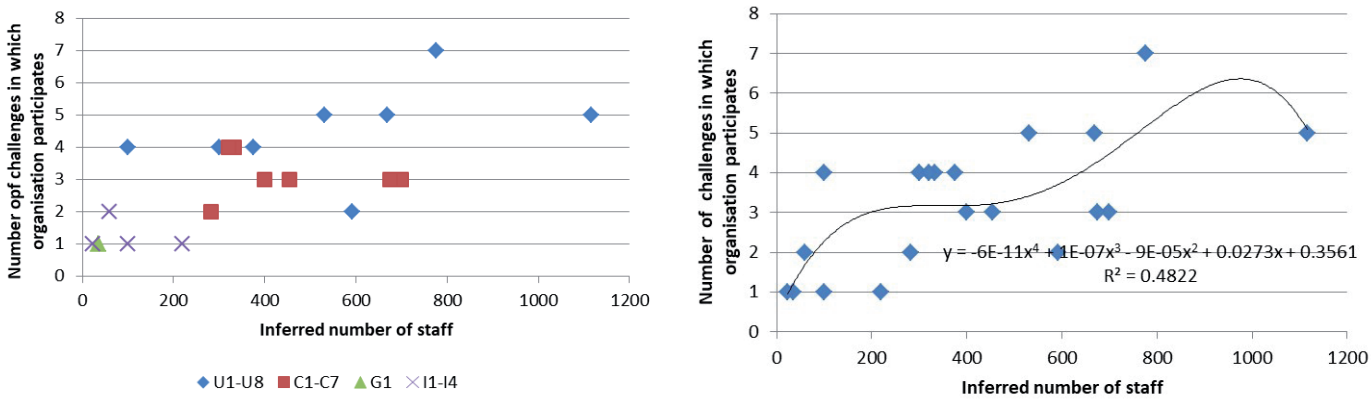

Figure 11. Variation of number of challenges with institutional size.

A (left): Universities, U1-U8; Crown research institutes, C1-C7; Antarctica New Zealand, G1; Independent institutions, I1-I4.

B (right): Line of best fit for all data is a 4th-order polynomial, with a correlation coefficient of 0.48.

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Science and evidence informing policymaking in New Zealand: The meth contamination story

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The following is based on a presentation given at the NZAS 2018 Annual Conference New Zealand Perspectives at the Interface of Science and Policy, and provides a brief overview of the complex story that led to the most dramatically impactful report produced during Sir Peter Gluckman's tenure as the Prime Minister's Chief Science Advisor – 'Methamphetamine contamination in residential properties: Exposures, risk levels, and interpretation of standards' (Gluckman et al. 2018). Release of the report rapidly shifted policies across a number of government agencies and abruptly curtailed the predatory practices of an industry which had flourished because of a particular failure in the science-to-policy exchange: no one had asked the right question.

What happened?

The tangled methamphetamine contamination story in New Zealand began with a real problem in need of solutions. Methamphetamine (meth) is New Zealand's major drug of abuse, and is either imported or is made domestically in clandestine laboratories (labs) in homes and garages. Such labs leave behind a range of hazardous chemicals and solvents used in the methamphetamine manufacturing process that can pose a risk to future occupants.

Recognising that contamination from meth labs was a potentially serious health issue in some circumstances, guidelines for cleanup of such labs were established in various jurisdictions internationally from around the mid-2000s. The easiest way to demonstrate that decontamination is sufficient is to require cleaning to a threshold level of methamphetamine on surfaces. This eliminates the need to test for every possible contaminant, which can vary according to method of manufacture. The guidelines therefore use methamphetamine as a proxy marker for other, more dangerous contaminants left behind from the manufacturing process. These toxins would not be present if methamphetamine was present only from use.

The guidelines (variably) provide info on:

- Triggers for screening – typically a police bust of a lab, or notification from a health authority
- Methods of screening and remediation – including the necessary qualifications of the persons performing these tasks
- Levels of surface methamphetamine residue allowable after remediation – usually 0.5–1.5 μg of meth/100 cm^2 surface area

In the absence of data on health risks for low-level methamphetamine exposure, the guideline remediation levels were initially based on the limit of detection of the screening instruments, assuming that any exposure was undesirable. While some efforts were later made to calculate health risks in relation to methamphetamine levels, these purposefully precautionary toxicological calculations were based on theoretical modelling exercises that were unrelated to real-world exposure scenarios.

As police discovered an increasing number of active or former meth labs in residential properties in New Zealand, attention to this problem increased, and the Ministry of Health followed international example, producing a guideline for clandestine lab remediation in 2010 (Ministry of Health 2010). The guideline set a post-remediation meth detection level of 0.5 μg/100 cm^2, based on the established Australian guideline level. As with other guidelines, the specified trigger for entering a house to screen for methamphetamine on surfaces was a police bust of a lab, or other notification of methamphetamine manufacturing activity. The purpose of the guideline was articulated very clearly – it was for cleaning sites where meth had been manufactured.

However, along the way, policies were developed, notably by Housing New Zealand, that applied the same standards to any house where methamphetamine might have been smoked. Such action has not been taken elsewhere where guidelines exist because the problem with lab contamination is not the methamphetamine, but the other chemical hazards. Nevertheless, following the example of decisions of Housing New Zealand and the Tenancy Tribunal, a number of city councils and the real estate industry began to apply the threshold level as a baseline test to detect methamphetamine residues from smoking. The application of the standard in this way dispro-

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portionately affected people of low socio-economic status due to its application to the social housing sector and by landlords in low-income rental areas.

On the back of these developments, a large unregulated testing and remediation industry grew up, using unsupported claims of harm from third-hand meth exposure to feed the public fear of meth contamination and increase the number of houses being tested. Houses were labelled contaminated based on findings of trace amounts of the drug, and companies advised that major remediation needed to be undertaken. Huge costs were incurred, both financially and socially, both for the government and private individuals caught up in the testing and remediation saga.

Where was the science?

In 2016 some scientists began to speak up, highlighting the irrationality of the fear and questioning the activities of the meth testing industry and evictions by Housing New Zealand. Their viewpoints gained some media attention (Goodwin 2016; Harris 2016; Radio New Zealand 2016), but the panicked response to the contamination issue continued.

The government's approach to the situation was to ask Standards New Zealand to develop standards in an attempt to regulate the meth-testing industry, whose practices were seen as inconsistent and unreliable. Science input was sought only tangentially to determine an appropriate level for detection level for methamphetamine after remediation, rather than asking if it was appropriate to use such a level for baseline testing. The result was to create an official standard – NZS 8510, released in July 2017 (Standards New Zealand 2017) – that effectively lent legitimacy to the questionable business model of the testing industry, allowing the practice of rampant testing and remediation to continue without consideration of the larger issue about whether the mitigation activities were commensurate with the actual risks.

A request for science advice

Following the change in government in 2017, the approach to methamphetamine contamination in the social housing sector began to change. The new Minister of Housing, Phil Twyford, questioned whether the new NZS 8510 standard was appropriate, and being appropriately applied. He approached the Prime Minister's Chief Science Advisor, Sir Peter Gluckman, in December 2017 to review the situation, focusing on health risks from exposure to methamphetamine on household surfaces. Because the current version of the Residential Tenancies Amendment Bill would have set the NZS 8510 standard into law, advice was needed to inform decisions around this.

When the Chief Science Advisor came to look at the problem it became clear that no-one had asked the core question – why was testing being done in the first place? Because testing was being done to avoid risks from methamphetamine itself, rather than the original purpose of avoiding risks from other hazards of the meth manufacturing process, further questions needed to be asked:

- What is known (and not known) about health risks from low-level methamphetamine exposure? What level of exposure might elicit a health effect?
- How did this relate to exposure to methamphetamine on household surfaces?
- What is the toxicological basis for guideline levels?

The New Zealand situation needed to be understood in terms of:

- The likelihood that significant exposure will occur in New Zealand houses
- Trends in meth use and manufacturing in New Zealand
- Other factors that need to be considered in a New Zealand-specific risk assessment.

The work included:

- An exhaustive literature review
- Search for case studies – literature and direct requests
- Data relating exposures to effects
- New Zealand datasets on meth levels in houses where use was suspected
- Involvement of a wide range of expertise and stakeholder perspectives.

Science advice and impact

The Chief Science Advisor's report found that there is currently no evidence that methamphetamine levels typically resulting from third-hand exposure to smoking residues on household surfaces can elicit an adverse health effect. Analysis of New Zealand-specific data indicated a very low probability of encountering excessive levels of methamphetamine in properties where meth lab activity is not suspected. Given these factors, and also considering the very conservative nature of the standards with respect to the risks of adverse effects from third-hand exposure to methamphetamine, testing was only recommended where meth lab activity is suspected or where very heavy use is suspected.

The input from the Chief Science Advisor was critical to the halting of wasteful and unfair policies, but not before much damage had been done. Had independent, rigorous, comprehensive science advice been sought earlier, leading to the right questions being asked and analysed from an unbiased, risk-based perspective before faulty standards were developed, the focus would have remained on meth labs, and the government would not be having to manage a lot of compensation for prior errors.

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Podcasts

Putting science and policy on the same wavelength

The following are two recent podcasts from podcast of Policy Forum.net - Asia and the Pacific's platform for public policy debate, analysis and discussion. Policy Forum is based at Crawford School of Public Policy at the Australian National University in Canberra, ACT. All content produced for Policy Forum.net is available for republishing and reproducing under a Creative Commons licence.*

How scientists can make themselves heard by policymakers

17 Aug 2018

https://policyforumpod.simplecast.fm/science

Can scientists make facts great again in an era of fake news? How can we get more young people and women studying STEM – Science, Technology, Engineering and Maths? Is humanity heading towards a science utopia or dystopia?

It's National Science Week in Australia (10–18 August 2019), and on this podcast we hear from four scientists working across physics, psychology, engineering, and climatology: Susan Scott, Eryn Newman, Elanor Huntington and Mark Howden.

In a wide-ranging interview, hosts Maya Bhandari and Sue Regan lead a discussion on how researchers can make themselves heard by the public and respected by policymakers, why science must find more common ground with the humanities, and why we need a new engineering for the 21st century.

Professor Susan Scott specialises in gravitational physics at the ANU Research School of Physics and Engineering. Susan was part of the team behind the breakthrough discovery of gravitational waves, winning awards for the way the science was presented to the media.

Professor Elanor Huntington is Dean of Engineering and Computer Science at the Australian National University. Elanor is leading a project to re-imagine a new type of engineering and computing, fit for the middle of the 21st century. (https://cecs.anu.edu.au/reimagine)

Professor Mark Howden is Director of the ANU Climate Change Institute. Mark was a major contributor to the Intergovernmental Panel on Climate Change reports for the UN, for which he shares a Nobel Peace Prize.

Dr Eryn Newman is a researcher at the ANU Research School of Psychology. Eryn's research focuses on distortions of memory and cognition, looking at how people can succumb to 'truthiness' – using feelings and pseudo-evidence to decide what is real, instead of drawing on facts.

Notes: The following were referred to in this episode:

Trapped in a culture of happiness by Brock Bastian at https://www.policyforum.net/trapped-culture-happiness/

National Security Podcast: Binary bullets with Adam Henschke and Chris Farnha at https://simplecast.com/s/78bc35d3

What do policymakers think of scientists?

14 Sep, 2018

https://policyforumpod.simplecast.fm/science

We hear from two senior figures in Australia's policy-making process about what it's like to be at the pointy end of policy creation and formulation, and receiving input – wanted and unwanted – from scientists.

Hosts Bob Cotton and Sue Regan chat to Ian Chubb, former Chief Scientist of Australia, and Taimus Werner-Gibbings, Chief of Staff to Tasmanian Senator Lisa Singh.

They discuss how to get evidence and data on the desk of a politician, the future of science in policymaking, and Ian's personal story of putting his life in the hands of an experimental cancer treatment. Listen here:

Professor Ian Chubb has had a long and distinguished career as a neuroscientist and an academic. He has served as Vice-Chancellor of both Flinders University and the Australian National University, and has been made a Companion of the Order of Australia. He served as Australia's Chief Scientist from 2011 to 2016, and was conspicuous in raising the public profile of science in the media.

* https://crawford.anu.edu.au/

Taimus Werner-Gibbings has worked for over a decade in the public service. He has been a Senior Policy Officer in the Department of the Environment, and a parliamentary staffer for both ministers and backbenchers, in government and in opposition. Taimus is currently Chief of Staff & Media Advisor to Lisa Singh, Senator for Tasmania.

Notes: The following were referred to in this episode:

Connections between science and policy – an event by the New Zealand Association of Scientists at https://scientists.org.nz/resources/Documents/NZAS%202018%20programme_v1.pdf

We need magic, not misery, from the wizards of Aus – by Sharon Bessell

Putting community engagement in the neighbourhood of good policy – with Paul Schmitz at https://policyforumpod.simplecast.fm/community

Putting the 'Indo' in Indo-Pacific – by David Brewster at https://www.policyforum.net/putting-indo-indo-pacific/

Abstract

Integrating evidence, politics and society: a methodology for the science–policy interface*

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There is currently intense debate over expertise, evidence and 'post-truth' politics, and how this is influencing policy formulation and implementation. In this article, we put forward a methodology for evidence-based policy making intended as a way of helping navigate this web of complexity. Starting from the premise of why it is so crucial that policies to meet major global challenges use scientific evidence, we discuss the socio-political difficulties and complexities that hinder this process. We discuss the necessity of embracing a broader view of what constitutes evidence—science and the evaluation of scientific evidence cannot be divorced from the political, cultural and social debate that inevitably and justifiably surrounds these major issues. As a pre-requisite for effective policy making, we propose a methodology that fully integrates scientific investigation with political debate and social discourse. We describe a rigorous process of mapping, analysis, visualisation and sharing of evidence, constructed from integrating science and social science data. This would then be followed by transparent evidence evaluation, combining independent assessment to test the validity and completeness of the evidence with deliberation to discover how the evidence is perceived, misunderstood or ignored. We outline the opportunities and the problems derived from the use of digital communications, including social media, in this methodology, and emphasise the power of creative and innovative evidence visualisation and sharing in shaping policy.

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THE CONVERSATION

The following article is republished from The Conversation, dated 6 November 2018. The article has not been edited, but we have attributed the author and her institute, given the internet citations, and used a non-copyrighted illustration.

Article

More experiments may help explore what works in conservation§

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All over the world, countless conservation projects are taking place, attempting to achieve aims from reducing habitat loss, to restoring populations of threatened species. However there is growing awareness[1] that conservationists have not always done a good enough job[2] at evaluating whether the things they do really work.

Efforts that fail to make things better for species and ecosystems waste the limited resources available for conservation, and result in missed opportunities[3] to stem the loss of biodiversity. Given that monitored populations of wildlife species have declined by 60% in the last 50 years[4], and large-scale loss of forest continues[5], this is bad news. So, research to show whether conservation efforts work really matters. And those doing conservation need easy access[6] to the results of this vital evidence[7].

In many fields, when researchers want to know whether something works they conduct an experiment. For example, patients are often randomly assigned to receive a new drug (or not) and the results are compared to determine if the new treatment has the potential to help people. Despite calls for more use of experiments in conservation, they remain extremely rare.

Experiments changing practice

One common approach to conservation is encouraging owners to manage their land in a way which provides benefits for the environment. This has been done in the UK for decades. For example, farmers are paid to maintain hedgerows and leave stubble on fields to help farmland birds[8]. These kinds of payments for ecosystem services schemes are increasingly used in the tropics[9] as well.

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The forests in the Bolivian Andes contain stunning biodiversity but are becoming fragmented due to small-scale farming. In 2017, an experiment in Uganda[10] revealed that paying farmers not to chop down trees was a cost-effective way to slow deforestation. Now we have published the results of only the second experiment at such a scale. Our study[11] evaluates whether providing incentives to farmers to protect forest and keep cattle out of streams improves water quality.

The research focuses on the efforts of the Bolivian NGO Natura[12], which has been working with communities in the Andes to help protect the area's incredible forests. These are home to spectacled bears and other wonderful wildlife, and are seen locally as important for supplying clean water. In Natura's Watershared programme[13], upstream landowners were offered

Tremarctos ornatus, **the spectacled bear, native to forests of the Andes, classed as Vulnerable due to habitat loss.**
Creative Commons: Hans Hillewaert

Professor Julia Jones is a conservation scientist interested in conservation impact evaluation (using quasi-experimental approaches, experimental approaches, and participatory impact evaluation) and the impacts of conservation interventions (including agri-environment schemes).

While her professional background is in ecology she has a focus on the social dimensions of conservation.

Professor Jones has a particular interest in Madagascar, where she has worked, with many Malagasy colleagues, for 18 years on issues around conservation and development.

§ https://theconversation.com/more-experiments-may-help-explore-what-works-in-conservation-106190

incentives to shift their livelihood activities away from clearing forest or letting cattle graze untended in the forest. Natura wanted to know if their innovative approach to conservation was working, so they took the unusual step of setting up an experiment to find out.

In 2010, 129 communities were randomly placed in a control group, or given the chance to enrol their land in Watershared agreements. Households in the latter 'treatment communities' could then choose to enrol as much of their land as they wished in the programme. Analysing the results of this experiment, we found that while keeping cattle out of rivers is (perhaps unsurprisingly) good for water quality at the location where it happens, the treatment communities did not have cleaner water in their taps. Further investigation revealed that this was at least in part because of the low level of uptake of the programme, and that the land most likely to be important for improving water quality was often not enrolled.

Natura is already implementing the results of this research to improve the design of Watershared. They are working with communities to ensure that protection is targeted to areas most likely to benefit water quality. And our experience with running such a large-scale experiment holds useful lessons for others interested in increasing knowledge about what works in conservation.

Doesn't everyone like an experiment?

Away from conservation, there has been an explosion in the use of randomised experiments[14] to evaluate the impact of other large-scale interventions – in development[15] and education[16], for example. However, there has been backlash from opponents, who have pointed out, among other things, that these kinds of investigations will not always provide valid answers to the most important questions[17] because these experiments can only normally answer the question, 'does it work?', rather than, 'why does it work?', and so can't really answer the other key question, 'will it work in other situations?'. This debate[18] has got quite heated, and even acrimonious, at times.

Running an experiment to evaluate the impact of a large-scale conservation intervention is certainly very challenging. It is often not possible to randomise which areas receive a new conservation project (can you imagine a government randomly allocating where it puts national parks?). There are also issues with achieving adequate replication, and there can be ethical concerns[19] which prevent experimentation.

However, given the importance of knowing what works in conservation, more high-quality evaluations (which won't always be experiments) are certainly needed. Only by learning from current practice can the future effectiveness of conservation be improved.

Endnotes

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News

International Science Council holds first General Assembly in Paris

The International Science Council, formed from the merger of two organizations representing the natural and social sciences, held its inaugural General Assembly in Paris on July 4,2018. Hosted by the French Académie des Sciences, the International Council for Science (ICSU) and the International Social Science Council (ISSC) merged to form the International Science Council, a unique global non-governmental organisation representative of both the natural and social sciences.

The meeting opened with addresses from Catherine Bréchignac, Secrétaire Perpétuel of the French Académie des Sciences, and Prince Albert II of Monaco.

The main item of business for the meeting was the election of a new President and a new Governing Board to lead the Council for the next three years. Representatives of the Council's members elected Daya Reddy, a mathematician from South Africa, to be the first President. Peter Gluckman, the former Chief Science Adviser to the Prime Minister of New Zealand, became the President-elect, and will assume the Presidency at the next General Assembly in 2021.

The other officers of the Board are Elisa Reis (Vice-President), Jinghai Li (Vice-President), Alik Ismail-Zadeh (Secretary), and Renée van Kessel (Treasurer). The ordinary members of the Board will be Geoffrey Boulton, Melody Burkins, Saths Cooper, Anna Davies, Pearl Dykstra, Sirimali Fernando, Ruth Fincher, James C. Liao, Natalia Tarasova, and Martin Visbeck.

In his acceptance speech, Daya Reddy spoke about the importance of inclusiveness, of involving all regions of the world in the work of the new Council. He called for the involvement of early career scientists in partnerships and agenda setting.

'We have set ourselves an ambitious goal to be a powerful, visible, credible voice for science. There's no time to waste. Let's get to work!'

Participants also voted for the location of the next General Assembly of the Council, choosing between two bids, one from Montreal, Canada, and one from Oman. The bid by the city of Muscat, Oman, carried the vote and it will host the 2nd General Assembly in 2021.

Earlier in the day, President-Elect Peter Gluckman spoke about his vision for the Council in remarks to participants before the vote.

He stressed that 'The International Science Council must work to become the leading voice of science in leading fora of policy-making.' He added that 'this requires a coherent and focused strategy asking where the Council is uniquely positioned – asking what the Council should do, and what it should not do.'

The inaugural events concluded on 5 July with a public launch event at the Maison des Océans in Paris. You can watch the public event on YouTube at https://www.youtube.com/watch?v=RFEuO8ptWZQ&feature=youtube

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RE: Complaint about the publication of letter from Doug Edmeades in *NZ Science Review* (2017) vol. 74(2)*

I am writing to complain about the publication of the correspondence from Doug Edmeades in *New Zealand Science Review* (2017), vol. 74(2), titled 'Is Mike Joy Biased?'. The letter is primarily two totally unsubstantiated and false statements about me, namely: (1) the claim that I say nitrogen is the only issue for freshwater in New Zealand; and (2) the claim that I said the Havelock water crisis was caused by dairy farming. Details below:

(1) In the last 20 years I have published around 260 items related to freshwater health, (45 journal articles, more than 100 public talks, dozens of plenary and invited talks at conferences, 9 book chapters, one book, more than 40 commissioned technical reports[1]) as well as television and radio interviews, and these all contained details on the many impacts on freshwater in New Zealand including the few mentioned in the letter, but in much more detail. I have never said nitrate is the only issue. What I have said is that in many New Zealand Rivers it is the biggest problem and I have given scientific details to support this.

(2) I have never said in public or private that the Havelock water crisis was caused by dairy farming. What I did say in the early stages was that the cause may never be known, and later, after the DNA evidence was released, I said it was likely to be ruminant. I said that this contamination of water supplies is not new and that in many other cases in New Zealand the cause in shallow bores was intensive farming, and I gave specific examples from Canterbury and Walkerton (Canada).

Mike Joy

6 November 2018

[1] https://www.victoria.ac.nz/sog/about/staff/mike-joy

*** The public dialogue between Drs Edmeades and Joy in *New Zealand Science Review* is now closed – *Editor*.**

Abstract

The construction of new scientific norms for solving Grand Challenges

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There is an increasing recognition that there is a class of problems that society must solve urgently in the twenty-first century if humanity is to survive into the twenty-second century – the so-called 'Grand Challenges'. Science policymakers have been active in recognising these challenges and the attendant need to develop new multidisciplinary ways of working. But embracing multidisciplinarity is not a straightforward choice for scientists, who individually are strongly steered by norms and values inculcated through their past scientific experiences. In this paper, therefore, we ask whether new funding approaches can contribute to creating new ways of working by scientists towards challenge-driven research, specifically by changing scientists' expectations and beliefs. We address this research question with reference to a single new experimental method, the 'research sandpit', implemented experimentally in a single national science system, Norway. Our data are derived from interviews with scientists involved in the five research projects funded as a result of the first sandpit, called 'Idélab' (idea lab) and held in 2014, and with the Research Council of Norway. We conclude that the sandpit approach appeared to shift research perceptions of individual scientists, particularly around long-term belief structures. This implies that, when well managed, the sandpit model can indeed be useful to generate multidisciplinary research as part of a multifaceted approach to funding scientific research.

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PALGRAVE COMMUNICATIONS| (2018) 4:52 |DOI: 10.1057/s41599-018-0105-9 https://www.nature.com/articles/s41599-018-0105-9.pdf

New Zealand Association of Scientists

Election of Officers and Council Members for 2018/19

At the 77th Annual General Meeting of the Association, held on Thursday 15 November 2018, the following people were elected as Officers and Council Members:

President	Heide Friedrich
Secretary	Fiona McDonald
Treasurer	Natalie Robinson
Membership	Charlotte Toma
Immediate Past-President	Craig Stevens
Editor	Allen Petrey
Councillors:	Simon Granville, Peter Buchanan, Nicola Gaston, Neil Broderick, Shaun Hendy, Troy Baisden, Tumanako Fa'aui, Kate Hannah, Naomi Fleming, Mike Berridge, Hamish Campbell

The New Zealand Association of Scientists
Co-Presidents' Report 2017/18

Over the last year we have trialled a co-presidency model. As ratified at the 2017 AGM, it was instigated to job-share the tasks of the President, and also improve the odds that a Co-President would be available at short notice. Furthermore, it aided in expanding our capacity to represent diverse views. We would argue it worked well and enabled us to drive processes, like the conference, in a way that allowed us to perform our day-jobs. Saying that, the provision in the Association's rules describe it as an option for the presidency but not mandatory. In the present year we have opted for a single President.

The issue of speaking out and conduct in the media was a recurring theme during the year and the President's Column touches on this. There will be some associated measures taken by the *New Zealand Science Review* in that it will reduce the profile of the correspondence section as there are now many ways of communicating opinions in the present media landscape.

We were pleased with how well it worked combining the conference with the NZAS medal awards. It rounded out the day nicely. It was also a pleasure to award the recently named Hill Tinsley and Cranwell medals as part of the regular medal process. There was good coverage in the media of the awards too. It was a near-even split between the Universities of Otago and Auckland. The Hill Tinsley Medal was awarded to Associate Professor Siân Halcrow, University of Otago. This early career award was for her remarkable work in bioarchaeological science. The Cranwell Medal awarded was to Dr Judith Bateup of the University of Otago for her tireless efforts to inspire school-aged students discovering the wonders of biological science. The Shorland Medal was awarded to Professor Jadranka Travas-Sejdic of the University of Auckland and the MacDiarmid Institute for her outstanding contribution to the field of advanced polymeric and nanomaterials and their application in biomedicine and bioelectronics. Two Marsden Medals were awarded this year – with a nice anecdote from Graeme Wake (himself a Marsden medallist) on meeting Sir Earnest Marsden. Professor John Montgomery of the University of Auckland was awarded the Marsden Medal for his wide-ranging research exploring Antarctic fish biology, flow sensing in fish, bioacoustics, shark sensory biology and cerebellar evolution. The other Marsden Medal went to Professor Warren Tate from the University of Otago for his contributions to molecular biology and the understanding of human disease as well as his guidance developing science policy and protecting research investment. It was especially poignant as Professor Tate's late brother Kevin was also a medallist. Thank you to Peter Buchanan for the smooth organisation of the judging efforts behind the scenes.

It has been a busy year moving to a new membership management software, with its associated effect on tracking our finances. We are presently contacting members to review their membership options and to stay up-to-date with their membership prescriptions. We are now offering an eMember category, which allows members to receive NZSR in electronic format. Because of the need to co-sign cheques, we, as an organisation, have not been the most agile of bill-payers. Internet banking has now advanced sufficiently to provide tools to maintain security, and we are pleased to say that we are now much better at paying our bills on-line. We thank Natalie Robinson for taking on the role of treasurer. Looking ahead, we aim to bring our membership database up-to-date, and continue to drive engagement with more than just the business-as-usual crowd. We are always looking at changing the way the Association works, and always welcome hearing from you on how we can help you and the science ecosystem in general. We will be in touch with you through a survey to better understand what we do well and where you think we should put effort in future.

We are having discussions on how we should go ahead with the *New Zealand Science Review* in this quick and fast-changing environment. We are looking at ways to modernise this important voice for the Association and for science, and big thanks go to Allen Petrey and Geoff Gregory along with the NZSR Editorial committee (Hamish Campbell, John Clare, and Mike Berridge) for working hard to keep up with demands, and providing a relevant outlet for reporting around science policy and ideas.

With the new government and appointment of a new Prime Minister's Chief Science Advisor, it has been a quiet year when it comes to new science initiatives. We maintained our media profile and contributed to discussions on the future of the National Science Challenges.

We thank retired Councillors Delphine Mitchell, Simon Lamb, and Neil Curtis for their contribution to Council over the years. At the AGM it was voted to discontinue with the Patron role, with a special motion passed thanking Neil Curtis for advocating for NZAS in his role as Patron. We welcome new Councillors Charlotte Toma, Kate Hannah, Naomi Fleming, Neil Broderick and Tumanako Fa'aui, who will be introduced in more detail in coming issues of the Review. Indeed, our sincere thanks, on behalf of membership, go to all of Council. Additionally we thank Fiona McDonald, who continues to do a stellar job keeping us on track with secretarial/organisational duties. It is a privilege to work with somebody as enthusiastic and full of ideas as Troy Baisden. Our past presidents Nicola Gaston and Shaun Hendy continue to provide well-received background support, and represent science issues in the media. Thanks also to Simon Granville, who regularly represents us at the Royal Society Te Apārangi's Constituent Organisation Forum and Speaker's Science Forum.

We also would like to thank Association members who helped out where needed. Craig will stay on Council and continue to be the main NZAS driver of a New Zealand version of 'Science Meets Parliament'. At the AGM, Heide was elected as the incoming President. We are looking forward to the New Year and seeing what we can achieve for New Zealand science.

Craig Stevens and Heide Friedrich
Co-Presidents

The New Zealand Association of Scientists Awards for 2018

The New Zealand Association of Scientists (NZAS) awarded its annual medals to New Zealand scientists for 2018, at a function held at the University of Auckland on Thursday 15 November. The ceremony followed the Society's annual conference

Associate Professor Craig Stevens, Co-President of the Association, noted that the awards seek to recognise and promote the recent past of both New Zealand science and our scientists. They also look to recognise future science leaders, and the importance of communicating what science is and does, now and in the future, to a range of audiences.

Four Medals are to be awarded.

- ***The Marsden Medal*** is awarded for a lifetime of outstanding service to the cause or profession of science, in recognition of service rendered to the cause or profession of science in the widest connotation of the phrase.
- ***The Shorland Medal*** is awarded in recognition of major and continued contribution to basic or applied research that has added significantly to scientific understanding or resulted in significant benefits to society.
- ***The Hill Tinsley Medal*** is awarded for outstanding fundamental or applied research in the physical, natural or social sciences published by a scientist under the age of 40, during the year of the award or the preceding three calendar years.
- ***The Cranwell Medal*** is made to a practising scientist for excellence in communicating science to the public in any area of science or technology.

Hill Tinsley Medal

Associate Professor Siân Halcrow, Department of Anatomy, University of Otago

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This year's Hill Tinsley Medal is awarded to Dr Siân Halcrow, who is an Associate Professor in the Department of Anatomy at the University of Otago. She is an outstanding and productive researcher, a trailblazer who has made fundamental contributions in her field of bioarchaeological science, focusing on the study of human remains in an archaeological context. Her research programmes are multi-disciplinary, cross-disciplinary and cross-cultural, involving both laboratory and field-based scientific research in a range of countries. Associate Professor Halcrow's studies in southeast Asia and South America investigating the adoption and intensification of agriculture have led to significant insights into the origins of human health, fertility and disease. Her work in prehistory is shedding light on previously understudied relationships, including those between maternal and infant health. Such analyses of stress and health in past populations are fundamental to increasing our understanding of human adaptation to environmental and societal changes.

Cranwell Medal

Dr Judith Bateup, Department of Microbiology and Immunology, University of Otago

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The 2018 Cranwell Medal is awarded to Dr Judith Bateup from the Department of Microbiology and Immunology at the University of Otago. Over two decades, Dr Bateup has built a hands-on and face-to-face science communication programme from scratch and with limited resources. She has exposed many thousands of students to a world they have not seen before and to the many ways that humans interact with microbes. Her resource packs for teachers have gone out to support biology teachers nationwide as well as teachers in the Cook Islands. Dr Bateup is also the convener of Hands-On at Otago, is on the organising committee of the International Science Festival, is a Schools Science Fair judge, and regularly speaks at conferences for scientists and science communicators. All of these activities are additional to her employment. Dr Bateup is a passionate advocate and effective practitioner of science communication in education at all levels.

Shorland Medal

Professor Jadranka Travas-Sejdic, University of Auckland; Principal Investigator, MacDiarmid Institute

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The 2018 Shorland Medal is awarded to Professor Jadranka Travas-Sejdic of the University of Auckland, and Principal Investigator of the MacDiarmid Institute. Professor Travas-Sejdic has made an outstanding contribution to the field of advanced polymeric and nanomaterials and their application in biomedicine

and bioelectronics, as well as sustained innovation and leadership in science and science translation. As the Director of the Polymer Electronics Research Centre at the School of Chemical Sciences, Jadranka has initiated and led programmes crossing chemistry, biology, medicine and engineering disciplines. Her research is highly multidisciplinary and collaborative, vibrant, creative and impactful, both nationally and internationally. Jadranka is a co-founder and the Executive Director of Spot-Check Technologies, a spin-off company based on her research in developing hand-held, cost-effective systems for the electrical detection of DNA, with applications including the detection of bacteria in water and of cancerous cells in human fluids. She leads the development of sensing materials suitable for industrially scalable fabrication of gene sensors in micro-array formats.

Marsden Medal: Joint Awardees

Professor John Montgomery, FRSNZ, School of Biological Sciences, University of Auckland

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Professor John Montgomery FRSNZ, from the University of Auckland, has made an outstanding and wide-ranging contribution to science. His research ranges from marine science to brain research, with key research themes including Antarctic fish biology, flow sensing in fish, bioacoustics, shark sensory biology, and cerebellar evolution. Professor Montgomery's strong contribution to the international research environment can be recognised through numerous high-profile publications, including papers in *Nature* and *Science* and a recent book on cerebellar evolution, as well as numerous national and international honours. The strength of his wider service to science is evident in his commitment to postgraduate supervision and mentorship, as well as to public outreach and engagement. For instance, he was the Director of the Leigh Marine Laboratory for 12 years, where he played a major role in engaging the public with marine science and garnering philanthropic support for the redevelopment of the laboratory. He was also integrally involved in the establishment of the Institute of Marine Science at the University of Auckland, for which he served as the Inaugural Director. Moreover, he has contributed to many other service roles, and he has been a Board Director of both the National Institute of Water and Atmospheric Research and AntarcticaNZ.

Professor Warren Tate, FRSNZ CNZM, Biochemistry Department, University of Otago

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Professor Warren Tate FRSNZ CNZM, of the Biochemistry Department, University of Otago, has a stellar national and worldwide reputation for his internationally recognised research discoveries in molecular biology and human disease, and his collaborative research. He is renowned for his national and global leadership and energy for developing science policy and protecting research investment. He has trained over 100 postgraduate students, many of whom have gone on themselves to have stellar research careers both in New Zealand and on the global stage in academia and industry. He has held many research-related leadership roles, nationally with the Health Research Council of New Zealand, the Science Board of the Ministry of Business, Innovation, and Employment, and the Maurice Wilkins Centre of Research Excellence, and internationally with the Human Frontiers of Science Organisation in Strasbourg, and the Asia Pacific International Molecular Biology Network. He has led and organised key 'first' international conferences in New Zealand. Professor Tate has presented and published extensively for both academic and community audiences.

NZAS
New Zealand Association of Scientists

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NZAS is an independent organisation working to:

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- Debate and influence government science policy
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- Encourage excellence in science

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