THE ROYAL SOCIETY OF NEW ZEALAND
PROGRESS & ACHIEVEMENTS REPORT

OCTOBER 2003

CONTENTS

EXECUTIVE SUMMARY

The Royal Society contributes to New Zealand's social and economic growth and development in two distinct, but complementary ways. In its first role it operates as an independent agency, established under an Act of Parliament to promote a critical awareness of science and technology issues in New Zealand societal and business affairs and to contribute to the science and technology education of New Zealand's young people. As an independent agency, it also provides professional services to scientists in the form of courses, support materials, and a code of ethics.

In its second role as a purchase agent, the Society administers government funding amounting to some $60m per year. Of that, $41m comes via the Ministry of Research, Science and Technology for the delivery of a range of programmes covering research chosen for its excellence, international linkages, support for outstanding teachers and researchers, and promotion of a culture of innovation.

In this report we highlight our contractual responsibilities to the Ministry of Research, Science and Technology, demonstrate how all of our activities align with New Zealand's Growth and Innovation Framework and, even more broadly, how they fit into an innovation spectrum which begins with the social, economic and infra-structural conditions necessary to inspire young people to embrace new knowledge.

The Main Points in this Report

The Royal Society believes that much work remains to be done to build a sound foundation for the appreciation and use of knowledge in New Zealand. The Society devotes much of its own limited resources to pursuing this goal.

We also believe that the professions of science and technology need rebuilding to a healthy and aggressive state. From a professional's point of view, satisfying careers imply status, stability and salary – and science and technology in general possess none of those characteristics. Our own resources are also channelled into support for the profession.

We put excellence to work for New Zealand, in the form of Marsden Fund grants for excellent research, and, as embodied in the Academy Council of the Royal Society, Teacher Fellows, James Cook Research Fellows, Award winners and outstanding young people.

Each of the recommendations below has a priority assigned to it.

Priority 1 Scientists need professional support, and the Society publishes, on behalf of government, a suite of learned journals. While costs of publication have been contained, government input to its own journals has reduced by 36% in real terms over the decade, to the extent that the journals face severe financial difficulty. Nevertheless, the Society sees scope for a vibrant publishing activity, with titles being added in environmental science, social science, and biotechnology/food systems.

> *We recommend a shift to "open access" publishing, where publication charges are met by author pay plus government coverage of the remaining deficit, and papers are then released free on the Web.*

Priority 2 The Marsden Fund Council continues to be able to Fund only a fraction of the applications made to it. Examination of applications below the cut-off reveals that increased funding would sacrifice little in the quality and excellence of research.

> *The Marsden Fund Council believes that the Fund could profitably be extended from its current $32.8m to $50m by 2006, with a concomitant increase in administrative support.*

Priority 3 New Zealand brims with young talent. The Royal Society helps to unleash this talent through such programmes as the privately-sponsored BP Challenge, our own CREST programme, and government/private sponsored regional/national science events such as *Realise the Dream*. We maintain a database of some 700 "young achievers" whom we update with newsletters, and we encourage to act as role models.

Many of these activities are under-funded to the point of ceasing operation. New Zealand will lose a generational opportunity if it fails to support these inspirational young people. The Royal Society will continue to seek sponsorships from all sources.

Priority 4 Government supports a $420k science promotion fund, administered by the Royal Society. This year, 9 out of 68 projects could be funded, reaching over 34,000 people to date, with more to come.

Highly creative ideas are being turned down by lack of funding in this programme. The promotion fund represents a highly effective use of government funding. The fund could profitably be increased by $200k. In addition, we support the idea of assisting unsuccessful applicants to find alternative sponsorship.

Priority 5 Communicating science and technology is a neglected but essential element in the interplay between science and society. The Royal Society now has a strong communications team which has leveraged other funds to supplement government funding to promote awareness through its Communicators, MasterClass and DNA50 programmes, resulting in some 200 talks and seminars over the year, and over 20 radio/TV appearances, in addition to the 500 or more lectures organised by our regional branches and the Royal Society's own "Distinguished Speaker" programme. The Society's theme events and high profile, international speakers have drawn large and enthusiastic audiences.

The Transit of Venus will be our major theme in 2004, mainly the first half of the year. It will encompass a nationwide competition for schools, a series of lectures, events, news and feature stories involving students and our top scholars, various international linkages, and a high quality website, developed as a resource for all students and teachers.

Priority 6 Essential support to professionals is also provided through the government's international S&T linkages fund. International links are imperative for a small country, and 73 scientists were supported in making such links via the fund. The Society also subscribes, on behalf of government, to 31 international science unions, assists New Zealanders to attend international conferences, and provides seed money to attract international conferences to New Zealand.

Scope exists for further attraction of international conferences to New Zealand, and for international joint symposia, in order to give New Zealand a presence on the world stage. Funding by a further $155k would bring significant paybacks to New Zealand.

Priority 7 James Cook Research Fellowships allow leading researchers to pursue specific personal research projects for two years. The opportunity develops them as role models, but limited funding has reduced awards to five per year.

In the absence of inflationary increases, funding is no longer available for 6 per year, or for extensions where warranted. The Minister may wish to restore funding levels to fund 6 Fellows.

Priority 8 In 2003, 58 science, mathematics and technology teachers were awarded fellowships for a life changing and re-energising year out of school, in technological or scientific practice. Most return to the classroom, while the few who don't, continue to contribute to education in creative and entrepreneurial ways. Primary teachers tend not to apply because they find it hard to specify a project. Māori/Pasifika teachers are also under-represented. Teacher applications do not fully reflect the emphasis placed on ICT, biotechnology and creative industries in the Growth and Innovation Framework.

Fund rules could be changed to allow 20 current fellowships to be earmarked for primary teachers, and 3 for Māori/Pasifika. Three new fellowships could also go to Māori/Pasifika, and

12 to biotechnology, electronics and creative industries (ICT is already covered by a Ministry of Education programme), with a concomitant increase in administrative support.

Priority 9 Medals and awards act as recognition for high achievers, but their main purpose is to inspire professionals to aspire to excellence. The Society awards the New Zealand medals on behalf of government, and supplements these with its own medals.

We perceive some gaps in the suite of medals, and are moving to institute a Pickering medal for technology. Possibilities also exist for Social Science and Antarctic medals.

DISCLAIMER

The Progress and Achievements Report

The Ministry of Research, Science, and Technology has requested that, on an annual basis, the Royal Society describe the results of its progress and achievements evaluation, draw out the policy implications, and give advice on future investment priorities.

Status of advice

The Royal Society of New Zealand is one of several purchase agents in the RS&T system, and consequently ours is only one of several streams of advice to the Minister. Our recommendations will be considered alongside those of the other purchase agents, the Foundation for Research Science and Technology, and the Health Research Council, and in the context of the Government's priorities. They are not government policy. Recommendations in this report are based on the Royal Society's current monitoring and evaluation information, and are thus indicative only and may change as further information becomes available.

Disclaimer

Every effort has been made to ensure the information presented in this report is correct, but the Royal Society is unable to guarantee the accuracy of data supplied to us by others. The recommendations on investment priorities and other opinions expressed in this report represent the views of the Royal Society of New Zealand.

THE ROYAL SOCIETY - PART OF THE INNOVATION LANDSCAPE

THE ROYAL SOCIETY WITHIN THE INNOVATION SPECTRUM

The innovation spectrum comprises the entire range of activities that turn new ideas into successful products. Much attention has been given to the place of research and development activities as a component within the innovation system. However, the Royal Society sees the beginning of this spectrum as being more broadly founded upon science and technology education and awareness of science.

Education and Awareness

Some of the participants in Auckland's Knowledge Wave conference supported the importance of the education/awareness end of the spectrum when citing recent evaluations of success in other countries. US professors Paul Romer and Richard Florida added that cities succeed in attracting knowledge enterprises not because they beat the incentives of others, but because they offer the right infrastructure and vibrant environment.

The Royal Society's activities cover an increasingly broad range across the innovation spectrum. They are particularly focused on the foundation areas necessary for innovation to occur. In addition to the activities that are supported by the Ministry of Research, Science and Technology, the Royal Society is energetically involved in education, public awareness and supporting RS&T professionals.

Supporting Professionals

The Society is also active in a part of the spectrum dealing with support for professionals in RS&T, which complements activities under the Ministry's "Supporting Promising Individuals" output class. Royal Society activities to support professionals include:

- publishing New Zealand learned journals;
- courses on communication for scientists;
- newsletters and daily news for scientists and technologists;
- support of the Australasian Research Management Society and 60 other science organisations;
- engagement with Māori science and technology;
- active international linkages and memberships;
- development and instillation of a code of ethics;
- studies on leadership qualities for innovation;
- several highly active committees leading workshops in (for example) social sciences, Antarctic research, climate change, human resources, care of animals, astronomy, and education;
- conference support for young professionals;
- the Society's own suite of medals, national awards event and professional science week;
- MasterClass events for professionals;
- distinguished speakers series, and;
- policy papers.

These professional support activities aid in the dissemination of results within and without the scientific community; they maintain international links; they promote and support best practices in NZ research and research management and they ensure all facets of the community have an input into science and technology. In this way, the RS&T community is strengthened, becomes more cohesive, directed, and a better communicator, both domestically and internationally.

The Science-Industry Interface

Lastly, the Royal Society is increasing its activity at the interface between research and those who require and use its results. Much needs to be done in New Zealand to increase the capacity of industry to specify research projects and embody their results in products or services. The Society has worked this year with New Zealand Trade and Enterprise (NZTE) to identify leadership characteristics and is working to find ways in which mutual understanding across the “valley of death” can be grown. The Society has also administered a $1.7m fund for NZTE to create a culture of enterprise in New Zealand.

Table 1. The Royal Society's activities within the innovation spectrum

Innovation Category	RSNZ Activity	RSNZ Spending ($k)		Total NZ Spending ($k)
		MoRST Funding	Other Funding	
Science-Industry interface	Enterprise Culture and Skills Activities Fund		1,700	1,700
	Leadership Study		[1]	42
Experimental development	Marsden Fund[2]	480		282,300
Applied research	Marsden Fund	490		485,500
Oriented basic research[3]	Marsden Fund	9,960		361,500
Pure basic research	Marsden Fund	18,280		286,500
Supporting the RS&T professions	Journal publication ISAT Other international activities Website and Alert Professional committees Professional awards and medals RSNZ Fellowships Total	402 295 150 75 847	 77 167 69 84 167	 Unknown
Supporting promising individuals	James Cook Research Fellowships Teacher Fellowships Total	720 2,351 3,071	 750 (Vote I&RD) 750	 11,170
Education	Realise the Dream BP Challenge Alphas and Gammas Publication	30 65	[1] [1] [1]	
	NZASE Agcarm Resource CREST awards NWP Waterways Enterprise Education		[1] [1] [1] [1] [1]	

[1] Commercially confidential material removed

[2] The categorisation of Marsden funding into basic, applied research and experimental development is indicative only, and should not be regarded as precise to less than approximately ±10-15%. A sample of Marsden projects were categorised by Marsden Fund Research Assessment staff, according to the Frascati definitions, 2002 (http://oecdpublications.gfi-nb.com/cgi-bin/OECDBookShop.storefront/EN/product/922002081E1). This allowed the determination of indicative percentages of pure basic, oriented basic, applied research, and experimental development, and from this, the predicted amount of 2002/03 Marsden funding for each research type was calculated.

[3] In the case of the Marsden Fund, the category "oriented basic" does not describe research which has been selected on the basis that it targets certain areas; no such targeting occurs within this Fund. Instead, it describes basic research, that the researcher does with the expectation that it will produce knowledge likely to form the basis of solutions to recognised or expected, current or future problems. Pure basic research, on the other hand, is carried out for the advancement of knowledge, without seeking long term economic, environmental or social benefits.

	Total	95	845	5,861
			[1]	
Awareness	S&T Promotion Fund	400	[1]	
	Other promotions activities	280	[1]	
	DNA 50 Celebration	20	[1]	
	Fostering Talented Young New Zealanders	90	[1]	
	Helix/Scientriffic		[1]	
	Total	770	179	Unknown

THE ROYAL SOCIETY WITHIN THE GROWTH AND INNOVATION FRAMEWORK

The Royal Society plays a role spread across many areas of the government's Growth and Innovation Framework (GIF). As a group, the Society's funding instruments met the broad goal of assisting the development of an innovation culture within New Zealand.

Specific instruments have more precise locations within the GIF, although for several, the outcomes will provide achievements in many of the GIF-targeted areas.

Marsden Fund

The Marsden Fund is explicitly focused on developing new knowledge, human skills and expertise and thus directly addresses the goal of growing our research and development capability.

The Fund grows and develops the skills and talent of people who are capable of carrying out world-class research to an excellent standard. The employment market for these people is global and they are part of the 'brain exchange'. The Fund is thus a key tool in the attraction of talent to and the retention of talent within New Zealand. Marsden funding has assisted the return of researchers to New Zealand, bringing back not just skills developed overseas but also global connections.

While the Marsden Fund does not target research that is intended to lead to future applications and the vast majority of Marsden research is basic, a result of funding such excellent research is that applications do arise. From 28 projects followed up in 2002/03, a third had actual applications in development.

Education and Awareness

The Royal Society works to promote science and technology in the primary and secondary education levels and also to the wider community. The wide range of activities and the provision of funding by external organisations shows the depth of the Society's experience in this area. The activities assist in the realization of the GIF goal of producing more talented people and a highly skilled population.

Table 2. Vote RS&T-funded RSNZ activities by GIF target area

GIF Target Area	**RSNZ Activity**
Strengthening the innovation framework	Science and Technology Publications
Growing NZ's R&D capability	Marsden Fund James Cook Research Fellowships
Growing and developing skills and talent	Marsden Fund Science, Mathematics and Technology Teacher Fellowships New Zealand Science and Technology Medals
Producing more talented people	Alpha and Gamma publications Fostering Talented Young New Zealanders Realise the Dream
Attracting and retaining talented people	Marsden Fund
Increasing global connectedness	Marsden Fund
Developing international networks and contracts	ISAT Linkages Fund International Memberships International Travel Assistance International Funding Assistance for Symposia/Workshops International visitors to the society
Strengthening the foundations	
Promotion of S&T within the education sector	Management of the Science and Technology Promotion Programme Contestable Fund for Science and Technology Promotion Alpha and Gamma publications Science, Mathematics and Technology Teacher Fellowships

Table 3. RSNZ activities funded from sources other than Vote RS&T, by GIF target area

GIF Target Area	RSNZ Activity
Strengthening the innovation framework	Professional committees
Growing NZ's R&D capability	Centres of Research Excellence
Growing and developing skills and talent	Science, Mathematics and Technology Teacher Fellowships [1]
Producing more talented people	Alpha and Gamma publication [1] Fostering Talented Young New Zealanders [1] Realise The Dream [1] BP Challenge ECSA NZASE Ag Carm Resource CREST awards NWP Waterways Enterprise Education
Strengthening the foundations	
Promotion of S&T within the education sector	Management of the Science and Technology Promotion Programme [1] Contestable Fund for Science and Technology Promotion [1] Alpha and Gamma publications [1] Science, Mathematics and Technology Teacher Fellowships [1]

[1] Co-funded from Vote RS&T and other sources.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

Priority 1: Journal Publishing

In line with a growing trend in world science publishing, the Royal Society advocates the free availability of published scientific information to as wide an audience as possible. The Society commends to government a view of publishing which sees publication as the final and essential step in the research process. Under the most developed version of this vision, processes for reviewing and editing of articles would be paid for by page charges. Articles would then be published free on the web for all to read. Two key objectives for New Zealand science would be met: 1) a readily available publishing avenue for New Zealand and regional papers, and 2) worldwide exposure of New Zealand authors and results.

By 2010 the Society would like to see a situation where:

- The Society publishes 10, not 7 journals, with titles being added to cover Social Sciences; Environmental Science, Ecology and Biosecurity; and Food Systems and Biotechnology. Each journal will be aggressively marketed to reach beyond New Zealand to include those parts of the Southern Hemisphere (e.g., Pasifika, South America, South Africa) where similar ecological or social questions exist (for instance in areas of biosecurity or indigenous populations).
- Journals are refereed and published electronically, and are available free via the web to readers worldwide. This follows a “public good” line of thought, where (government) funds are invested in 1) ensuring international exposure for New Zealand science, and 2) a waiver of page charges for authors not in receipt of funding.
- Papers are published electronically on an "as ready" basis, for later assignment to a designated issue or issues. Annual bound versions are printed if demanded for purchase and for archive purposes.
- Publication is seen as a legitimate and integral step in completion of the research. Thus, New Zealand-funded and overseas authors would pay a publication charge. This would be waived for non-funded New Zealanders.
- For New Zealand institutions, costs are mostly shifted from reader subscription to author (i.e., institution) pay. For some institutions, overall costs might go down due to decreased subscription charges, while for others they may increase, due to increased page charges.
- Where appropriate, academic editors would be sought as a prestige position, and would receive an honorarium.

In the Society’s view, the scenario above would:

- give the journals a solid focus as “Southern Hemisphere” regional journals;
- give New Zealand authors access to world-wide readership;
- be in line with current moves to “open access” as technology allows; and
- be financially viable with continuing “public good” input from government.

Author page charges are expected eventually to progress to the point where all publishing costs will be covered by the appropriate research organisations and funders. However, until such time as this occurs, there will remain a proportion of cost, particularly of the printed journals, which must be recovered by subscription charges to the users.

In the short and medium term, the Society recommends that:

- the Society continues to publish all 7 journals (subject to funding availability);
- the Society appoints an academic editor for JRSNZ;

- funding be provided to relieve the current deficit, and further, funding be restored to pre-inflationary levels;
- the Society continues to implement cheaper and more effective distribution options;
- the Society continues to improve electronic review and production processes;
- the Society works towards its stated long-term goals for publishing, and that the means be made to enable us to do this; and
- the government support free access to the journals as a "public good".

Priority 2: Marsden Fund

There are four aspects to the changing nature of the Marsden Fund that require consideration. In order of importance for 2003, these are:

- increasing the Fund to enable a greater proportion of the applications to succeed;
- increasing the Fund to recognise increased research costs;
- increasing the funding provided for administering the Fund to provide for:
  - the recent and planned growth of the fund,
  - the need for an executive with enhanced evaluation and policy analysis capacity to support the Marsden Fund Council; and
  - an expansion of the planned promotion activities to mark the 10th anniversary of the establishment of the Fund.
- developing and increasing the Fund in order to add to the types of awards made, in particular to fund an expansion in collaborative research with international researchers.

To increase the effectiveness of this form of investment in New Zealand's future, the Marsden Fund Council has a goal to increase the size of the Marsden Fund to $50 million by 2006. This would involve a substantial increase to the Fund from its present level of $32.8 million for 2003/04. The measures outlined in this report involve increases of $12.55 million per year to the Fund.

This and previous reports have emphasised the value that would be obtained from increasing the proportion of applications funded. Although the Marsden Fund is an elite funding instrument and is targeted at excellence, applications have a very low success rate by international standards. The overall cost, both indirectly to the research community of preparing applications, and directly to the government of evaluating proposals, is high compared with the amount of research ultimately funded. The current success rate of 14.2% (for 2003/04) is well below that of the Australian Research Council who target 25% for their Discovery Fund.

Additional funding provided in the 2003 Budget, together with a change in policy on the balance of funds that needed to be retained against forward commitments, enabled the Council to make an especially large number of awards in 2003. The extra "one-off" funds released enabled the success level to be raised to 14.2% from its historical level of approximately 10% with no sacrifice in the quality and excellence of the applications funded.

There is widespread concern about the cost to researchers and their institutions of preparing applications to a Fund with a low success rate. While this is compensated for by the prestige that is associated with an award, the Fund will be under pressure to continue providing funding at an acceptable level. The ability to achieve his will be affected by the impact in the next funding round of the universities costing proposals with new higher overhead rates.

To achieve a success rate of 13% for the Marsden Fund would require additional funding of $5.8 million per year based on the current number and size of applications. In addition, an increase to the Fund of between $2.95 and $4.6 million is required to fully allow for the impact of the new indirect cost regime for universities. The research community has also been concerned about the trend from the Marsden Fund Council to compensate for pressures on the Fund by funding a proportion only (approximately 75%) of each research project selected, thereby potentially compromising the ability of

the researchers to fully deliver. A smaller increase of $1.64 million is also recommended to allow the Marsden Fund Council to increase the average size of funded projects to 80% of that requested.

The Marsden Fund Council's strategy for the development of the fund includes introducing some longer-term awards, and developing new awards for particular segments of the research community. One particular focus is to provide more opportunities for researchers to link into international research programmes by providing parallel funding for collaborating with prominent international researchers. New initiatives proposed for 2004/05 are to develop a separate component of the Fund to co-fund, with the Australian Research Council, collaborative research with Australian researchers at an initial cost of $1.6 million per year and also to increase support given to emerging researchers through the Fast-Start scheme by increasing the award amount from $50 k to $70 k per year at a cost of $0.56 million.

Other recent developments of the Fund included introducing some longer-term awards. The first of these were offered in 2003; however they will not have an impact on the size of the fund until 2007.

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Priority 3: Talented Young New Zealanders

The reception that these activities have had with young people and the benefits from the international participation indicate that the scheme is highly valuable and that it must be continued and strengthened in the future. The new initiative, *Realise the Dream* will assist. We also welcome the establishment, in the 2003/04 Output Agreement, of a small contestable fund to contribute to travel costs for students attending international events for which no travel sponsorship is available. In light of our experience with the London International Youth Science Forum, applications for which increased 400% (particularly from lower socio-economic groups) when travel sponsorship became available, we fully expect demand for this fund to greatly outstrip supply. We are seeking an increase in the size of this fund.

Many activities that promote the value of science and technology take place within schools. These are implemented on a voluntary basis by teachers and others, and are reliant on goodwill and/or sponsorship for their survival, and therefore their benefits are sometimes not as great as they could be. It is within the scope of this output for the RSNZ to identify such worthwhile activities and programmes and provide management in a collective manner. Many of these activities are underfunded to the point of ceasing operation. New Zealand will lose a generational opportunity if it fails to support these inspirational young people. The Royal Society will continue to seek sponsorships from all sources.

Priority 4: Science Promotion Fund

The Science and Technology Promotion Fund delivers excellent value for money and is often used by projects to leverage additional commercial sponsorship monies. Following the wide public interest in the DNA50 programme (run by the Royal Society) which has covered major centres across New Zealand throughout 2003, we have seen the effectiveness both economically and promotionally, of tying-in a large number of projects under one banner or theme. Further investigation of this method could lead to an increase in the effectiveness of the investment from the Science and Technology Promotion Fund.

Each year the variety of imaginative projects to apply for funding is large but the bids amount to 10 times the available funding. A review of the Fund in March 2002 noted the level of dissatisfaction among applicants at the continuing low level of funding for the promotion of science and technology. The Royal Society fully supports the initiative by MoRST to provide funding for a sponsorship programme (in 2003/04) to encourage projects not in receipt of Promotion Fund awards to gain commercial sponsorship. However, we also strongly recommend the Fund be increased by at least $200,000 (an increase of $20,000 was received in 2003/04).

Priority 5: S&T Promotion Programme

In the light of the success of the DNA50 theme this year, the Ministry has agreed to provide funding for bringing overseas speakers to New Zealand and organising the media promotion of them. The

Royal Society has already leveraged considerable support from non-government funds for these activities. This is an area where the Royal Society recommends that funding be directed in 2004/5.

The Society is able to attract considerable financial support from other sources, but sponsors invariably want to pay for the tangible, visible things, not Society administrative time. The Society is in a unique position, in that it is the only scientific organisation in New Zealand that is able to nucleate such coordination and collaboration between agencies.

The Royal Society Communicators course is highly valued by participants in terms of what they learnt, and the motivation and confidence they acquired. The feedback from community groups using the communicators has been extremely positive. The Society will continue the course on a user-pay basis, relying on participants or their employers to pay the course fee.

Priority 6: International S&T Linkages

Following their review of the ISAT Linkages Fund in 2002, MoRST allocated an additional $265k to the ISAT funds administered by the Society, and the scheme was changed to permit grants to be made for up to 3 years. Scope exists for further attraction of international conferences to New Zealand, and for international joint symposia, in order to give New Zealand a greater presence on the world stage. Funding by a further $155k would bring significant paybacks to New Zealand.

Priority 7: James Cook Research Fellowships

The increasing numbers of recent James Cook Research Fellows who have opted to remain in New Zealand for all or most of their Fellowship reflects the fact that although the funding may be sufficient to maintain a Fellow in New Zealand, it does not cover the escalating cost of working in an overseas university or institution. If the benefits of this Fellowship are to be maximised it is vital that future Fellows are encouraged to travel overseas, by providing a larger stipend to account for the varying fortunes of the New Zealand dollar, and the increased cost of living overseas.

In the absence of inflationary increases, funding is no longer available for six Fellows per year, or for extensions where warranted. The Minister may wish to restore funding levels to fund 6 Fellows.

Priority 8: New Zealand Science, Mathematics and Teacher Fellowships

To address under-representation in specific areas, Fund rules could be changed to allow 20 current fellowships to be earmarked for primary teachers, and 3 for Māori/Pasifika. Three new fellowships could also go to Māori/Pasifika, and 12 to biotechnology, electronics and creative industries (ICT is already covered by a Ministry of Education programme), with a concomitant increase in administrative support.

Priority 9: New Zealand Science and Technology Medals

Medals and awards act as recognition for high achievers, but their main purpose is to inspire professionals to aspire to excellence. The Society awards the New Zealand medals on behalf of government, and supplements these with its own medals. We perceive some gaps in the suite of medals, and are moving to institute a Pickering medal for technology. Plans also exist for Social Science and Antarctic research medals.

MARSDEN FUND

1 Overview

Purpose and Objectives

The Marsden Fund occupies a unique position in New Zealand's research environment. It provides project funding for the very best curiosity-driven research. In doing so, the Fund supports and encourages excellence in the advancement of knowledge, expands the knowledge base, and broadens and deepens the research skill base in New Zealand. It enhances the quality of the research environment by providing opportunity for investigator-initiated research and supporting national and international linkages and multidisciplinary research. The Fund is a small, but significant contributor to the principles of the Growth and Innovation Framework in that it fosters innovation in research of the highest quality, develops people with skills and talent and increases global connectedness.

In 2002/03, the Marsden Fund operated as a separate Output Class under the Knowledge Goal of the RS&T system, with an investment budget of $30.839 m (23.6% of the Knowledge Goal investment, 6.16% of Vote: RS&T).

The Fund's chief characteristics are that projects are selected each year in a highly competitive funding round on the basis of excellence alone. They are investigator-initiated and their selection is not subject to government priorities for economic, social or environmental development. Funding the best work by the best or most promising researchers allows researchers to explore new areas of research and can lead to serendipitous findings.

Scope and Scale

During the year, 357 research contracts were operational, covering the humanities, social sciences, sciences, mathematics and engineering.

Each year, approximately one third of the total budget becomes available for new projects from expired projects and new money allocated to the Fund. The distribution of funding by research area, for contracts commencing in the current year, is shown in Figure 1.

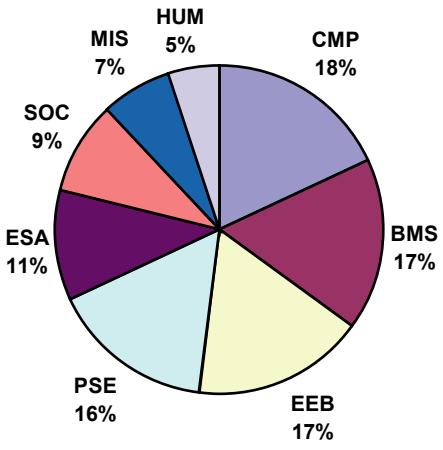


Figure 1. Funding by research area for new contracts in 2002/03.

The research areas are:

CMP - Cellular, Molecular & Physiological Biology;

BMS - Biomedical Sciences;

EEB - Ecology, Evolution and Behaviour;

PSE - Physical Sciences and Engineering;

ESA - Earth Sciences and Astronomy;

SOC - Social Sciences;

MIS - Mathematical and Information Sciences;

HUM - Humanities.

For these new research contracts, 52% of the funding is for the medical and life sciences, 34% for the physical sciences, earth sciences and mathematics, 9% for the social sciences and 5% for the humanities. This is almost the same as for the previous year.

Providers

Eligibility is unrestricted, provided that the research is carried out either in New Zealand or, if its nature demands, carried out elsewhere by New Zealand-based researchers. Over the years, contracts have been awarded to universities, Crown Research Institutes, research associations and institutes, private individuals and companies. Universities as a whole are the largest group of providers and in 2003 submitted 76% of the proposals, across all areas of research. Proposals from the CRIs represented 18% of the total, mainly in the life and earth sciences, with very few in the social sciences and humanities.

The proportion of new funding awarded by institutional group in recent years is given in Figure 2. Each group's share had remained approximately constant between 1998 and 2002, but in the most recent round the universities' share increased significantly to 87% at the expense of all other providers.

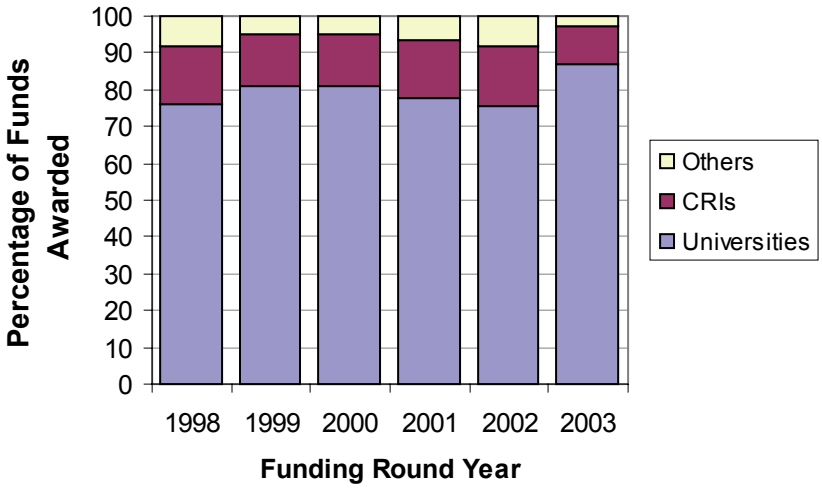


Figure 2. Proportion of new funding of all contracts by institutional type and year. For administrative purposes each contract has a lead institution that is used in this figure, although many contracts involve collaboration with researchers at other institutions.

Users

The Marsden Fund supports projects at the cutting edge of their discipline that explore new ideas, develop fundamental understanding and enhance knowledge for future innovation. In doing so, Marsden funding contributes strongly to the development of a highly skilled research workforce.

A notable feature of Marsden funding is that it leads to a disproportionately higher level of research outputs than other similar funds. Although the Marsden Fund represents less than 2.5% of New Zealand's gross expenditure on R&D, it contributes more than 7.5% of publications (Figure 4). Marsden contributes strongly to new knowledge as evidenced by citation rates that are twice that for other New Zealand publications (Figure 5). Marsden projects can lead to strategic and applied research that, ultimately, provides social, environmental and economic advances for New Zealand. A recent tracking survey of sources of intellectual property at The University of Auckland[1] over the last three years showed that 44% of its new patents had arisen from basic research such as that funded by Marsden whereas those funding sources had represented only 37% of funding. Conversely targeted research contributes 15% of the research income, but only 7% of new patents. The same survey showed that "blue skies" research was the driver behind all but one of the universities' 17 "spin-out" companies.

[1] M. Buckley, "Funding Fundamentals", *Biotech Unlimited*, 10-12 September 2003

Marsden researchers participate in research of international significance, ensuring that New Zealand contributes to, and gains from, global knowledge. Knowledge developed in Marsden projects is published and is widely available to other researchers and interested parties, unless there are intellectual property considerations. The Marsden Fund regards the dissemination of knowledge to the general public, through media, community activities and teaching, as an essential activity.

The Marsden Fund also fosters people with knowledge, skills and ideas. It supports some of New Zealand's best and most experienced researchers. For example, of the 7 recently established Centres of Research Excellence, 44 of their directors and researchers (47% of the total) had received previous Marsden funding. The Marsden Fund provides significant support for new and emerging researchers for New Zealand's research and innovation system. For new grants announced in 2002/03, the first year of funding provided for 59 postgraduate positions and 36 postdoctoral positions. The Fast-Start programme supports a further 18 emerging researchers.

2 Highlights

2.1 Key Features for 2002/03

The Marsden Fund supports a diverse range of research which includes studies of genetics, developmental biology, the environment, health, children and adolescents, natural hazards, climate change, information technology, new materials and nanotechnology, and marine research. It also supports research of specific interest to Māori. The range of research is summarised in Appendices II and III.

2.2 Breakthroughs

Aluminium is the most common metal on Earth, and its presence makes much of the world's soil infertile. As an important step towards overcoming this problem, a Marsden researcher has demonstrated that aluminium acts to poison living organisms by denying cells an essential element: magnesium. In other work on the environment, genetic techniques are being used to examine the family structure of endangered dolphin species, providing information that will be essential for the successful management and preservation of these species. Similar methods are being used to test the effect on biodiversity of Fiordland's highly subdivided and diverse range of marine habitats. The findings from this research are not only contributing to scientific debate on marine ecology but also to environmental management of the region.

In the biomedical sciences, a Fast-Start researcher has demonstrated that superantigens produced by bacterial infections are implicated in streptococcal toxic shock syndrome, and may be involved in other severe diseases such as necrotising fasciitis. A route to a possible vaccine has also been identified. Some more longstanding work into the effect of blocking cell communication has led serendipitously to a therapy for treating spinal injury, stroke, and skin wounds, and currently is headed for clinical trials. Another researcher has discovered a synthetic protein fragment that reduces the production of a specific type of blood cholesterol and, by carrying out fundamental biochemistry, has optimised its effectiveness 2500 fold to produce a potential new anti-cholesterol drug.

Two separate geological projects have had their early results published in the prestigious journal, *Science*. In one, a comprehensive database of New Zealand marine molluscs throughout the past 65 million years has been assembled to test hypotheses about the controls on biodiversity through time. In the other, the initiation of zones where tectonic plates overlap has been studied, and it has been discovered that, for Fiordland, this process was initiated around 12 million years ago. Another group of geologists has focused on improving electrical methods of "seeing" below ground. Their results show that there is a single unifying principle underlying such methods, and that methods currently in use can be significantly enhanced. Their work has attracted the interest of the geothermal power generation industry.

In the humanities, New Zealand's heritage has been a strong theme. Researchers have been using resources unique to New Zealand, the Mobile Unit Archives and other collections of recordings of speakers throughout their lives, to determine how the pronunciation and usage of NZ English has changed over the past 150 years. Dame Anne Salmond's much lauded book, *The Trial of the Cannibal Dog: Captain Cook in the South Seas*, has just been released. This has been described by Michael King as "a triumphant synthesis of modern scholarship and storytelling". Also published

during the year were *Rere atu, taku manu*, which uncovers the wealth of information in the Māori-language newspapers, and the full collection of the poems of Robin Hyde, *Young Knowledge*, edited and introduced by Michele Leggott. Vincent O'Sullivan has completed his biography of the New Zealand writer, scholar, and soldier, John Mulgan – *Long Journey to the Border* is to be launched shortly.

New Zealand physicists, chemists and engineers have been at the forefront in the development of new materials. One group is not only increasing the variety of materials which become superconductors at easily achievable temperatures, but their experiments are making a real contribution to theoretical considerations of the superconducting mechanism. Another group has clarified the role of the amino acid, proline, in stabilising collagen, which is the important structural constituent of skin, hair, nails and cartilage. Some other chemists have created a nanoscale light and switch assembly, and are now looking at developing devices with a NERF grant. A team of engineers is also aiming at devices, by producing the common material zinc oxide in novel ways, so as to alter its electrical and optical properties. And other work, which has investigated the way in which organic molecules are synthesised in interstellar clouds, has hastened the development of a sensitive gas sensor. The "sniffer", as it is called, is now being commercialised for a wealth of applications including health, biosecurity, and oil exploration.

Many of our mathematicians continue to enhance and maintain their place among the world leaders in their fields, such as in logic and computation, and structural aspects of graph theory and matroids. Key results in these fields are being obtained through Marsden funding. Such is their success that outstanding overseas mathematicians are choosing to seek permanent positions in New Zealand to join research teams here. In a related area, two mathematicians have written the first book to present a modern mathematical treatment of phylogenetics, which is a central tool for evolutionary and molecular biology. This book was published by Oxford University Press in 2003.

In the social sciences, the Ta Moko project is investigating the origins, significance, and technology of this practice. Social aspects have proved to be interesting. For instance, a study of the way that others perceive and react to wearers of facial tattoo has shown that many Māori have high expectations of them, and this can put pressure on the wearers. Two psychology projects are investigating memory issues. A Fast-Start researcher is working with volunteers who have difficulty in finding the correct words they need to express themselves, following strokes or other forms of brain damage. The researcher has found that the introduction of competing words can either help or hinder, depending on the whether the competitive word is related by sound or meaning to the word being sought. Another project is concerned with prospective memory, the ability to remember to carry out a future action. The researchers have designed a computer game to test for the effects of traumatic brain injury and also of aging. Both projects have implications for cognitive theories, as well as the testing and treatment of patients.

In a multidisciplinary project, a Fast-Start researcher and her team are developing new statistical methods and applying them to communities of fauna in the holdfast of kelp. They have discovered that there are no significant differences in the relative abundances of different taxa, even when the kelp are separated by large distances. Since the response of the various taxa to environmental deterioration will vary, this suggests that the holdfast fauna can provide an environmental indicator. In another multidisciplinary project, state-of the-art optical techniques are being used to map the connecting channels between the cells which make up the lens of the eye. In the absence of blood vessels, these channels provide nutrient supply routes. The mapping provides fundamental knowledge which may, in time, provide insights into cell death, cataracts, and cancer.

2.3 Research Strengths and Areas Under-Represented

Current projects feature some particular areas of concentration of effort and research strength. These are listed in Appendix III and include protein structure and biochemistry, genetics and molecular biology, molecular evolution, synthetic chemistry, condensed matter and extremely low temperature physics, climate, several areas of mathematics, psychology and linguistics. There are also areas of research that are under-represented – either because there are few Marsden applications in those areas or because the applications have failed to win funding. These are also listed in Appendix III.

3 Progress and Achievements Evaluation

3.1 Building New Zealand's Knowledge Base

3.1.1 Research Productivity and Dissemination

A study has been conducted to count the number and type of Marsden publications, including those that have arisen since grants have finished. The number of publications per year has increased steadily, from 27 in 1994, to 544 in 2001 and the rate of increase shows no sign of decline (Figure 3). The majority of publications are journal papers (Appendix I, Table 10).

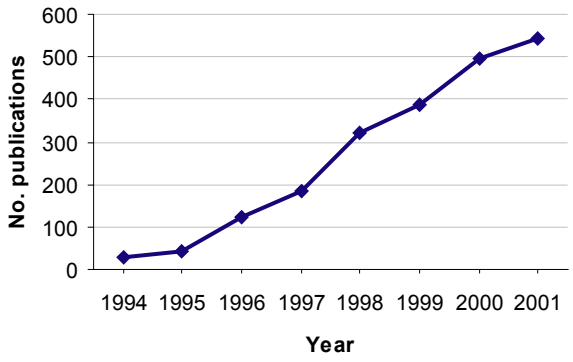


Figure 3. Number of publications per year funded by Marsden.

A bibliometric study has also been undertaken to analyse the quantity and impact of Marsden-funded research publications. During the period 1997-2001, publications attributed to the Marsden Fund accounted for 5.6% of New Zealand-authored publications. However, the percentage share has increased with time, from 2.6% in 1997, to 7.7% in 2001 (upper curve, Figure 4). Marsden's percentage share of gross expenditure on research and development is shown in the lower curve.

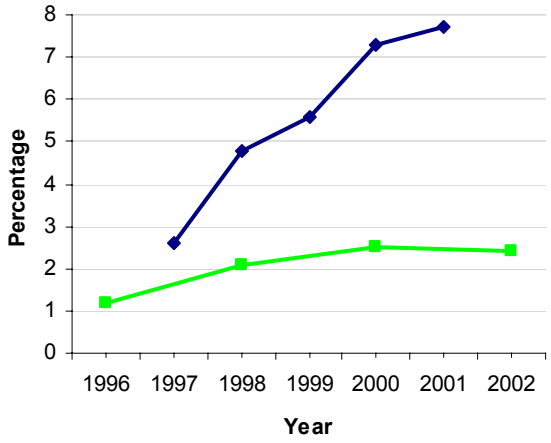


Figure 4. Percentage of NZ research publications funded per year by Marsden (upper curve) compared with the percentage of New Zealand's gross expenditure on research and development that is spent through the Marsden Fund

Marsden-funded research results are also communicated at conferences, and through radio and newspaper interviews, hui and community meetings, documentaries and general interest publications, and by contribution to, or construction of, online or digital resources (Appendix 1, Table 11).

3.1.2 Research Quality

The number of citations received by a paper is a widely accepted measure of its visibility and impact. Figure 5 shows the average number of citations per paper in the period 1997-2001, for Marsden papers (blue bars) and NZ-authored papers (red bars). Marsden-funded papers are cited at twice the New Zealand average. The elevated Marsden citation rate is consistent across all fields of study. This demonstrates an impact well above that of other New Zealand research.

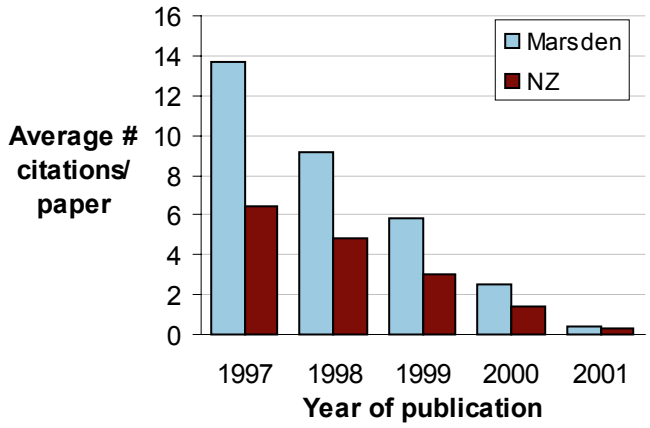


Figure 5. Number of citations for Marsden and NZ papers. The decrease in citations for more recent publications is because the citations have been accumulating for less time.

Other measures of quality include numerous publications in prestigious journals, and prizes and awards received by Marsden researchers (Appendix I, Section 1.2).

International referees' grades and comments provide another measure of research quality. The grades assigned to full proposals from the 2002/03 funding round are shown in Figure 9 and a small sample of comments from referees are given in Appendix I (Table 13).

3.1.3 Seeding Further Research

"When the Marsden Fund awarded me a major three-year grant in 1997, little did I realise that it would be a significant stepping-stone to future research endeavours" – Dr Sydney Shep, Victoria University of Wellington

In the 2002/03 year, 28 completed Marsden projects were evaluated to find out where the research had led. 60% of these projects had greatly influenced the researchers' further research, by:

- opening up a new area for investigation;
- allowing a progression to more advanced research on the topic;
- informing follow-on applied research; and
- in one case, allowing the founding of a company to develop the research commercially.

30% had a lesser impact on researchers' further work, in the form of:

- methods that are now being applied to other projects;
- wider collaboration;

- continuing write-up of results from the project; and
- researchers doing a little work in their own time.

10% did not influence ongoing research, in one case because the research had come to a successful closure and in two cases because bids for follow-on funding were unsuccessful.

68% of the projects did lead to further funding. The sources of this are shown in Figure 6.

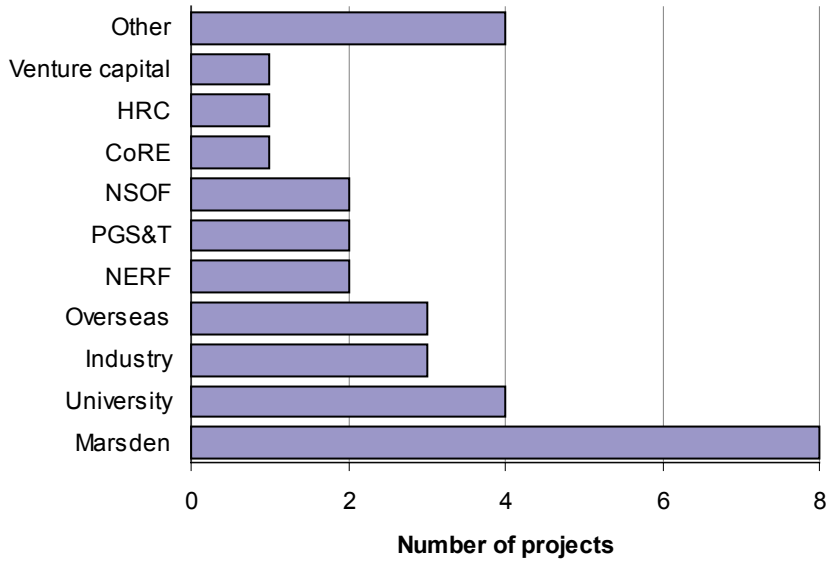


Figure 6. Sources of funding for the projects in the survey that led to further funding. Some projects led to funding from more than one source.

"I applied for and received a substantial grant from the Trustees of the National Library of New Zealand to research and create an electronic monograph. ….. What began as a Marsden has now blossomed into new kinds of research and exciting new forms of publication." – Dr Sydney Shep, Victoria University of Wellington

3.1.4 Downstream Applications of Marsden Research

Although the Marsden Fund does not target research that will lead to future applications, and there is no suggestion that it should do so in future, a consequence of funding excellent research is that applications do arise. With the 28 projects followed up in 2002/03, 9 of the 28 projects had applications in development, and a further 5 had future applications in-mind[1]. Types of actual and anticipated applications included new technologies, methods to increase industry productivity, horticulture, aquaculture and fisheries applications, medical applications, development of new materials, hazard reduction, and social outcomes. Specific examples include a very sensitive gas sensor with a host of applications (currently being commercialised), a potential drug to lower cholesterol, and an improved method for mapping out geothermal sources.

The results of this follow-up evaluation correspond with a 2001 survey that showed that for 22% of Marsden-funded principal investigators, the Marsden research had helped in obtaining funding for more applied research or for commercial ventures. Ways in which Marsden projects were said to contribute to applications are illustrated in the following quotations from principal investigators.

[1] Future applications were counted as those for which the project was *specifically* related to the anticipated application, not those for which the anticipated application was a more general aim of the research field.

"Three of our Marsden grants have given rise to reagents/methodologies that we aim to patent, and that are being fed into involvements we have with two major New Zealand companies."

"As a result of discoveries made doing the Marsden work we have moved toward more applied research, carrying out studies which lead toward clinical trials and biotechnology industry applications."

"The Marsden research has been the core science at the heart of my research programme, and the work that has attracted the highest international attention. That profile has made it possible for us to attract buyers for our commercial ventures, as part of our NERF research programme. Thus there is a nice synergy between these two programmes."

"The fundamental work we completed during our Mardsen-funded programme has provided a good basis for application in both our FRST funded programme and several other research contracts."

"The data analysis methodology developed in the Marsden research is being used in my applied (and HRC-funded) research."

3.1.5 Building Capacity for Future Needs

An important feature of Marsden-funded research is its diversity, providing a robust setting for new ideas. New methods and skills developed also provide a launching pad for the exploration of areas of research that may not be foreseen at present but which will be important in the future. An example is the funding by Marsden of the first grant in the world for a subject that has become a major topic in mathematics, and is now known as geometric integration.

Bibliometric analysis shows that Marsden-funded papers have been published across the whole spectrum of subjects (Figure 7). The distribution of Marsden papers is more heavily weighted towards basic research than is the distribution of New Zealand-authored papers, but a significant number of Marsden-attributed papers have nevertheless been published in the more applied subject areas of engineering, IT, health sciences, and agriculture, veterinary and environmental studies.

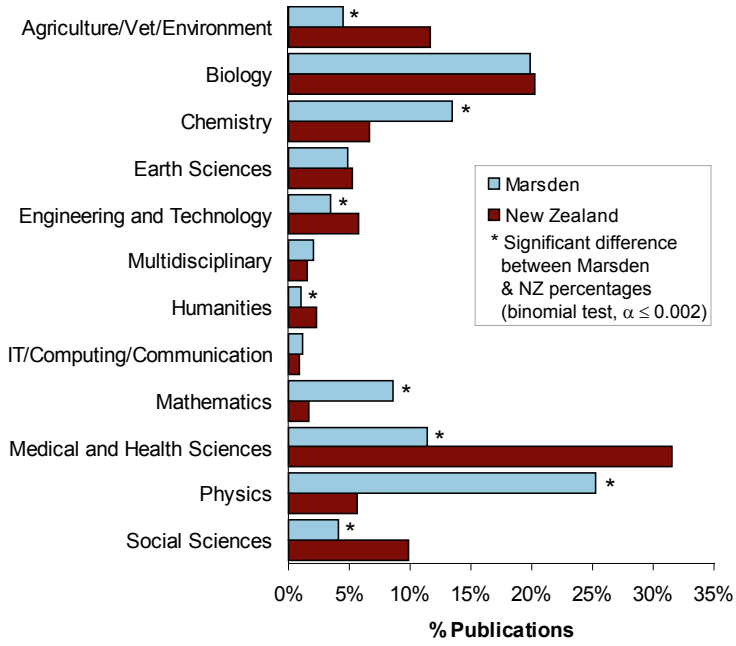


Figure 7. Comparison of the subject distribution of Marsden-attributed and New Zealand-authored papers. Light blue bars indicate Marsden-attributed papers in each field as a percentage of all Marsden-attributed papers, and dark red bars indicate NZ-authored papers in each field as a percentage of all NZ-authored papers.

3.2 Enhancing Global Connectedness

3.2.1 International Research Collaboration

A significant percentage of Marsden contracts (38% in the 2002/03 funding round) involve international collaboration at their inception, but many more develop international links during the course of the project (Table 4), resulting in the majority of projects (65% in 2002/03) involving international collaboration. Data for the previous 3 years are similar.

Table 4. International collaboration and communication on Marsden grants.

International collaboration and communication	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003
International collaboration – Percentage of successful proposals in the year's funding round with PIs and/or AIs from overseas	30%	34%	26%	38%
International collaboration – Percentage of current contracts with international collaboration (excepting proposals funded in the year's round)	73%	67%	67%	65%
International Presentations – For current contracts (excluding those awarded in the year's funding round), the percentage for which work has been presented at international conferences	67%	63%	65%	72%

The bibliometric study of Marsden-funded publications shows that, compared to other New Zealand papers, a higher percentage of Marsden-funded papers have co-authors from overseas (Figure 8).

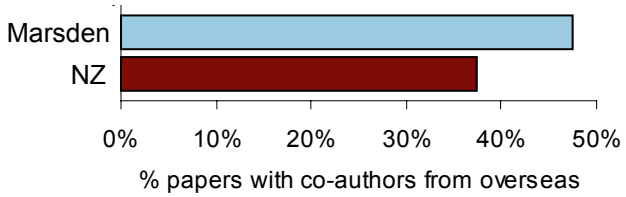


Figure 8. International co-authorship of Marsden-funded papers as compared to all New Zealand-authored papers.

In the 2001 survey, 15% of the principal investigators surveyed stated that the Marsden grant had led to overseas funding, in the form of funding for equipment and project expenses (8%), postdocs/students (5%), and travel expenses (5%). The survey also revealed the importance attached to the opportunities Marsden affords for establishing international connections. 17% said that this was a way in which the Marsden research had fed into or changed their other research, and 30% felt that it was a factor in increasing the capabilities of their group.

Appendix I (Section 2) has further information on international collaboration. Collectively, the data show that Marsden grants are an effective way of achieving this.

3.2.2 The "Brain Exchange"

Investigators on Marsden grants are often able to use the funding to attract students and postdoctoral fellows from overseas. Sometimes these students and postdocs are funded with Marsden funds, and in other cases, they are attracted by the research, and obtain their own fellowship funding from sources outside New Zealand.

In the 28 projects that were followed-up in 2002/03, 43 postgraduate students were trained, 2 of whom were from overseas, and 24 postdoctoral fellows were trained, around 14 of whom were from overseas.

In the 2001 survey, 10% of Marsden principal investigators stated that their Marsden grant had been a significant factor in retaining or attracting researchers to New Zealand. The value of Marsden is captured in the following comments.

"It has certainly influenced my career as it has meant that I have returned to NZ from an overseas institution to do the research work."

"It has brought researchers here from around the world, raising the international profile of my research group."

It was also felt that the ability to use Marsden funds to travel or to attract overseas visitors to New Zealand was immensely valuable. For example:

"Using the grant to promote travel by our own group and to be able to invite people here either as short term visitors or as participants in workshops has opened up lines of communication that could not have been imagined in the pre-Marsden days."

"It has definitely enhanced our capability - giving us opportunities that would not have been possible without this funding - for example, enabling us to travel overseas to conferences and to work with other leaders in our field (or have them visit us)."

"It has allowed us to retain experienced staff who would otherwise have left, and brought us senior international experts as visitors to enhance our expertise."

3.3 Building Human Capacity

Dr Geoff Whittle from Victoria University received Marsden funding for work in an area of discrete mathematics known as algebraic matroid theory.

Discrete mathematics is a growing area because it has applications in computation. The field of algebraic matroids is so new that the immediate need is to understand and characterise matroid properties. In 2000, a major breakthrough was made in doing just that, leading Dr Whittle to describe the year as *"perhaps the most exciting in my whole research career".*

During the course of the grant, Dr Whittle was promoted to professor and was elected as a Fellow of the Royal Society of New Zealand. His overseas collaborator, an associate investigator on the grant and a regular visitor to New Zealand, received the prestigious Fulkerson Prize for an outstanding paper in the area of discrete mathematics. The postdoctoral fellow wrote a public domain program which is becoming the standard computational tool for matroid researchers worldwide. The two Masters students both received Commonwealth Scholarships to undertake PhD studies at Oxford. Another collaborator, who had been a student on the preceding Marsden grant and won the Hatherton Award, was appointed to a tenured position at Canterbury University and has received Marsden funding in his own right.

3.3.1 Quantity and Type of People Supported by Marsden

The participation of various groups in Marsden projects is shown in Table 5. There is strong support for new researchers, as demonstrated by the large percentage of projects that support emerging researchers, postdoctoral fellows and postgraduate students. The percentage of principal investigators who are women is currently 22%, reflecting the percentage of applications received from this group. The number of Māori researchers is low, which causes large fluctuations in the percentage from one year to the next. In part to address this low participation by Māori, the Marsden Fund Council has introduced a "Responsiveness to Māori" section into the application form for the 2003/04 funding round.

Table 5. Participation in Marsden grants.

Building human capacity	**1999/ 2000**	**2000/ 2001**	**2001/ 2002**	**2002/ 2003**
Investigators – Number of separate individuals acting as principal and/or associate investigators on current contracts[1]	660	729	769	791
Emerging researchers – Percentage of PIs[2] on contracts awarded in the funding round who have received their highest degree within the last 10 years	26%	27%	38%	38%
Postdoctoral fellows – Percentage of standard contracts in the year's funding round which involve postdoctoral fellows[3]	47%	44%	47%	47%
Students – Percentage of contracts in the year's funding round which involve postgraduate students[4]	47%	70%	49%	57%

[1] **Current contracts** - those operating in the government financial year indicated.

[2] **PIs** - Principal investigators - are researchers who lead the research, contribute the main ideas and are responsible, with their institution, for the achievements of the objectives and the management of the contract.

[3] **Postdoctoral fellows** are emerging researchers who have completed a PhD, usually within the last few years, and are employed on contract (often of 2-3 years). They do much of the day-to-day work on the research programme, and are looking to gain experience to establish themselves as permanently employed researchers.

[4] **Postgraduate students** are researchers who are working on a Masters or PhD thesis.

Women – Percentage of female PIs on contracts awarded in the funding round	18%	18%	25%	22%
Māori – Percentage of Māori PIs and AIs[1] on contracts awarded in the funding round	1.6%	0.9%	4.0%	1.3%

Appendix I (Section 3) has further information on building human capacity.

3.3.2 Attracting and Retaining Skilled People

Marsden funding has attracted researchers to, and retained them in New Zealand. When asked if Marsden had influenced their careers or the careers of others, 90% of principal investigators in the survey stated that it had a positive impact, for example, by training researchers so that they could attain independent research posts, by helping people to stay in research, by giving people the opportunity to progress in their careers, and by encouraging people to return to New Zealand. The principal investigators had the following to say.

"It allowed me to attract back to NZ a New Zealander working in the US."

"Without the Marsden fund support I simply could not (and would not) have been able to stay in NZ."

"Funding from a successful Marsden bid was the reason I was able to return to NZ to take up a permanent position with this CRI."

"A very bright up and coming young scientist remains at Massey University because of support received from the Marsden Fund."

"Without my Marsden funding I would have probably left New Zealand by now."

Through our 2002/03 follow-up of 28 completed Marsden projects, we found that some Marsden postgraduate students and postdoctoral fellows remained in New Zealand, while others had taken research positions overseas. Senior researchers often expressed a desire to in fututre attract back their very best students and postdoctoral fellows. For example, one Marsden researcher described a former student, currently settling into a research position overseas, as being "head and shoulders" above the other 24 PhD students he had supervised.

A tracking survey of Marsden postdoctoral fellows[2] showed that 86% of formerly Marsden-funded postdoctoral fellows had been retained in research, 50% of whom were working in New Zealand at the time of the survey. Of those who were overseas, 20% said that they wanted to return to New Zealand, and 66% were unsure. This plus the evidence from our follow-up suggests that there would be much interest in a scheme to attract our best young New Zealand researchers back to the country.

3.3.3 The Fast-Start Scheme for Emerging Researchers

The second year of the Fast-Start programme, which provides grants of $50k per annum for 2 years, saw 18 applications funded, following on from the 20 last year. While it is too early for a full assessment of the scheme, monitoring shows that the Fast-Start scheme is achieving its aim of allowing researchers to establish independent research, with outstanding results obtained (as featured in the Highlights section). Four of the 2001 Fast-Start researchers have obtained standard Marsden grants in the 2003 funding round. For experimental subjects, the $50k limit is proving to be too low, an issue which the Marsden Fund Council has addressed.

[1] **AIs** - Associate investigators - are researchers who play a lesser role than principal investigators and sometimes are involved with only limited aspects of the work.

[2] Victoria University (2001) Tracking Survey of Scholars and Fellows http://www.frst.govt.nz/evaluation/TrackingSurvey.cfm

4. Strategic Direction

The strategic analysis of the Fund has focused on its position within the RS & T environment, its scope and its impact to determine whether changes are needed to maximise the Fund's benefit.

The Marsden Fund occupies a unique position in New Zealand's research environment. It provides project funding for the very best curiosity driven research. In doing so, the Fund supports and encourages excellence in the advancement of knowledge, expands the knowledge base, and broadens and deepens the research skill base in New Zealand. It enhances the quality of the research environment by providing opportunity for investigator-initiated research and supporting national and international linkages and multidisciplinary research. The Fund is a small, but significant contributor to the principles of the Growth and Innovation Framework in that it fosters innovation in research of the highest quality, develops people with skills and talent and increases global connectedness.

Problems highlighted by the analysis are:

- a large number of high quality proposals not funded (or low application success rate);
- the impact of price increases on the ability to fund complete projects;
- the perceived overlap with other funding mechanisms; and
- the increased pressure on administration and support services provided for the Fund by the Royal Society.

Opportunities identified are:

- Increasing collaborative links with the best overseas research.

4.1 Funding more high quality research

The low success rate of applications to the Fund is the Marsden Fund Council's major concern. In the 2002/03 funding round only 10.7% of applications received were funded. This level compares poorly with international success rates for similar funds. For example the Australian Research Council targets a success rate of 25% for its Discovery Grants which is a similar untargeted fund for high quality research. The Marsden Fund Council notes that each year there are a significant number of applications that reach the excellent standard required for a Marsden award but are unable to be funded. A related concern is the relatively high cost to the research community of preparing applications for a fund with a low overall success rate. In the 2003 funding round just announced, new awards totalling $43.8 million were made with no sacrifice in the excellence standard. A success rate of 14.2% was able to be achieved. This amount of funding was a one-off event arising from a change in the policy on the timing of fund distribution, but it does demonstrate that there is capacity to offer funding at a higher rate and maintain standards.

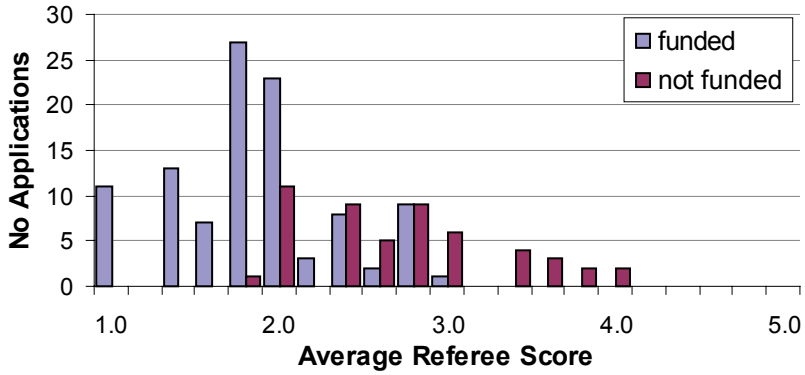


Figure 9. 2003 Funding round – distribution of referee scores

An assessment of the further potential for increasing the proportion of proposals chosen for funding was made by analysing the grades given to the 2003 proposals by the 512 international referees used in the peer review process. Figure 9 shows that the 104 proposals chosen for funding had referees' grades in the 1.0 to 3.0 range. There were a further 41 proposals whose assessment fell into the same quality range and if these had been funded, the success rate would have been at 19.6% with no sacrifice in quality.

Based on previously announced increases to the Marsden Fund for 2004/05 and 2005/06, the Council will be able to make awards of approximately $34 million and $35 million in 2004 and 2005. It is therefore likely that the success rate for applications in those years will fall below 11%. To achieve a success rate of 13% would require an additional $5.8 million. This is a conservative estimate, because the number of proposals able to be funded is also likely to be affected by increases in the cost of research (see below).

The benefit of an increase of this magnitude would be the increased quantity of high quality research undertaken and the consequent expansion of the contribution to the knowledge base in New Zealand.

4.2 Compensating for the increased cost of research

Each year the cost of standard research proposals submitted to the Fund increases. In the 2001 round the average presented cost was $216k. This increased by 7.4% to $232k in 2002 and by a further 3.8% to $241k in 2003. An even larger increase is anticipated for the 2004 proposals as the universities move to show their indirect costs at more realistic levels than previously. Based on the indirect cost rates being discussed by the NZVCC with the Health Research Council, the price increase could be in the 9 – 14% range. If this were the case, an additional $2.95 million – $4.6 million would be required in order to maintain the Fund's purchasing power.

Concerns over the level of funds available have resulted in the Marsden Fund Council not being able to make awards at the requested funding levels. After scrutinising the budgets they have adopted a practice of offering the successful applicants funding at reduced levels to widen the number of researchers supported. In the 2003 funding round, the average dollar award was 75% of that requested. This compares with 79% in 2002 and 73% in 2001. The Council are reluctant to continue this practice as it has the potential to encourage overbidding and penalises those applicants who submit well structured and costed proposals. A move to 100% is not anticipated as there are elements of the proposed research programmes that are not considered suitable for funding, and some unnecessary costs are always identified when scrutinising the budgets. However, a move to 80% of that requested is desirable and would require a further $1.64 million.

Cost drift has also compelled the Marsden Fund Council to increase the amount offered to the smaller Fast-Start awards from $50k set in 2001 to $70k from 2004. In 2003 there were 28 Fast-Start awards. If a similar number of awards are made next year an additional $560k will be needed.

An increase of the magnitude indicated will enable the Council to build on the initiative first introduced in the 2003 funding round of making some longer-term awards. These were introduced to ensure that research on some of the best Marsden projects could be continued. This was desirable as traditional funding sources for strategic research do not offer new funding in all discipline areas every year. It would also permit the introduction of new funding initiatives planned for the 2005 round to create opportunities for increasing the global connectedness of New Zealand research. A new option for a Marsden award will be to link a Marsden application to one submitted by their collaborators to an overseas funding agency (see below).

4.3 Differentiation of the Marsden Fund from other sources of research funding

The Marsden Fund is often referred to as a basic research fund. Much of the research it funds can be classified as basic research, but that is not the Fund's unique feature. What makes the Fund unique in the New Zealand environment is that it is intended to fund the very best investigator-initiated research chosen solely on the basis of excellence. The Fund has an extremely broad reach in that it is able to choose projects from all discipline areas each year, providing they reach the required excellence standard. The other major funds in New Zealand that support basic research, for example NERF and aspects of HRC funding, are targeted to potential economic, social or environmental outcomes and therefore fulfil a different niche in the funding spectrum.

The Marsden Fund Council intends highlighting the unique position of the Marsden Fund and the benefits it brings to New Zealand such as support for the research community, the encouragement of excellence in the advancement of knowledge, expansion of the knowledge base, and the broadening and deepening the research skill base in New Zealand, by taking more advantage of opportunities to promote the Fund and its researchers. This will include special events associated with the 10th anniversary of the establishment of the Fund.

4.4 Increasing collaborative links with the best overseas research

An already strong feature of the Marsden Fund is the contribution it makes to global connectedness. Section 3 above provides information on the level of international collaboration, including involvement of foreign researchers, joint publication of research and the travel and exchange opportunities for New Zealand researchers generated by Marsden Funding.

A further opportunity to expand the connections with the best overseas researchers would exist if a small part of the Marsden Fund were devoted to co-funding research projects that involved formal international collaboration. Attention has initially been given to opportunities to increase the connections with Australian research. The Australian Research Council (ARC) operates a Discovery Fund that is similar to the Marsden Fund and applications to that fund are evaluated within a similar timetable to Marsden. Discussions are still at an early stage, but the ARC has indicated a willingness to consider a process where applications could be made to each agency to co-fund the respective national component of a joint research project. Single joint applications are not seen as feasible initially because the ARC marginally funds research, whereas the Marsden Fund uses a full cost funding regime, however, linked applications are possible. It is proposed that the Fund be expanded by $1.6 million to initiate co-funding for trans-Tasman research.

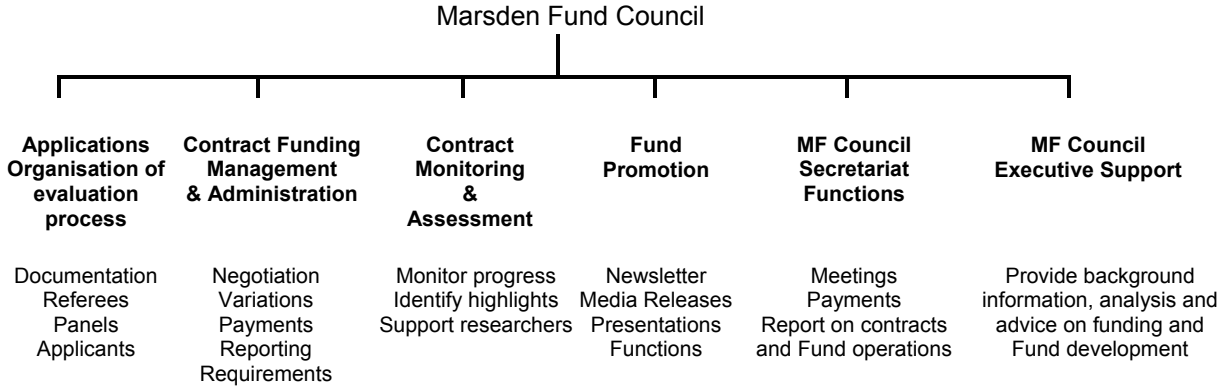
4.5 Support and Administration Activities

The establishment of the Marsden Fund Council (MFC) at the beginning of 2002 to replace the former Committee created an expectation of new roles, responsibilities and support functions for both the Council and the Royal Society. A MOU between the Council and the Royal Society describes the arrangements. In particular, the Council takes a stronger role in

- governance and direction in relation to the management of the Fund;
- providing policy advice to the Minister on the development of the Fund; and
- promoting the Fund.

In addition to its fund administration activities, the Royal Society as the executing arm of the Fund, will undertake more policy analysis and advice to the Council.

The expanded range of functions carried out by the Royal Society is shown in the diagram below. The new activities expected by the Marsden Council are also shown.



To be able to provide the additional services and functions, the Royal Society is expanding its support team by recruiting new staff to form a policy advice unit. This additional capability will be critical for providing the Council with information on the options for future development of the Fund and the benefits to be delivered from new types of awards.

4.6 Marsden Fund 10th Anniversary

The 2004/05 year will mark the 10th anniversary of the establishment of the Marsden Fund. The Fund was originally administered by the Foundation for Research, Science and Technology as the Basic Research Fund. The first applications were called for in late 1994 and the first awards made in 1995. Both the Marsden Fund Council and the Royal Society plan to mark the occasion with a series of events that will celebrate the success of the Fund, highlight some of the best research supported by the Fund and promote the Fund to the research and the wider community. The Council also plans to make some special awards, or prizes for some of the best research carried out over the 10 years.

A special "one-off" increase to the administration fee is sought to run the celebration events at locations around the country and to provide for the special awards to be made.

SUPPORTING PROMISING INDIVIDUALS

JAMES COOK RESEARCH FELLOWSHIPS

1 Overview

The James Cook Research Fellowships are awarded to "forward thinking" researchers who will make a significant contribution to New Zealand's knowledge base. The Fellowships allow them to concentrate on their chosen research for two years. These two years of dedicated research enable them to focus a lifetime of study and scholarship on issues that advance New Zealand's role in knowledge creation.

The James Cook Research Fellowships are awarded as funding permits in the following categories:

- Biological sciences;
- Engineering sciences and technologies.
- Health sciences;
- Physical sciences;
- Research of relevance to the peoples of New Zealand and/or the Southwest Pacific; and
- Social sciences.

The Fellowships have the following objectives:

- The encouragement of sustained excellence within the particular disciplines covered by the Fellowship; and
- the strengthening of existing and new research within the particular disciplines covered by the fellowship.

The James Cook Research Fellowship scheme is a part of the "Supporting Promising individuals" output class. As such, it contributes to the development of people with knowledge, skills and ideas. This output contributes mainly to the Knowledge Goal and this report will highlight one example of this.

During 2002-03 there were nine active James Cook Research Fellowships and these are listed in Appendix IV.

Professor Gaven Martin asked for a one-year extension to his Fellowship and an extension has been approved until April 2004.

Applications in the areas of Biological Sciences and Research of Relevance to New Zealand and the South-West pacific were called for in early 2003 for a start in March 2004.

2 Highlights

Three Fellows finished their Fellowships within the 2002-03 period and all produced excellent research during their tenureship. Below is one highlight of a Fellow's research:

Accurate knowledge of the electromagnetic power system behaviour is crucial to operating an economic, efficient and environmentally friendly power systems network without compromising on the reliability and quality of electrical power supply. In recent years such behaviour has been greatly improved by the use of power electronic devices.

With the help of a James Cook Research Fellowship, which ended on 30 April 2003, Professor Jos Arrillaga FRSNZ has reviewed the state of, and developed new models for, the simulation of these power electronic devices in power systems. The two-year Fellowship was spent at the University of Canterbury in close collaboration with Dr Neville Watson of the Electrical and Computer Engineering Department.

In thanking the Royal Society of New Zealand for the financial support and the University of Canterbury for providing an ideal setting for the purpose of the Fellowship, Professor Arrillaga commented in his report that full-time dedication to research is rarely available to an academic and it has made it possible to increase the research output considerably.

During the two years he also found time to complete, with Dr Watson, three books in the area of their investigations.

3 Progress and Achievements Evaluation

The Royal Society, via the Academy Council, has received 6-monthly and final James Cook Research Fellowship reports and general summaries and these are assessed by academy councillors with expertise in the particular discipline for the quality and progress of the research. In all instances there has been clear evidence that Fellows have made good progress in the stated goals and that the achievements have added to the knowledge base within the particular disciplines.

4 Policy Implications and Future Investment Priorities

The James Cook Research Fellowship Terms of Reference (ToR) previously stipulated that the Fellowships be awarded to senior researchers who are recognised leaders in their respective fields. It has been the Royal Society's opinion for some time that the Fellowships would be better targeted to researchers who are recognised leaders in their respective fields rather than to "senior" scientists per se, as there is evidence that some people are put off from applying because they don't feel they fit the "senior" category The Ministry has agreed to a change in the wording of the ToR. The definition of those eligible to apply has been broadened by removing the word "senior" in the ToR. "*Fellowships are to be awarded annually to researchers who are recognised leaders in their respective fields"*. This amended ToR better meets the objective of "Supporting Promising Individuals" who can have further input into the innovation system during the later part of their careers.

The increasing numbers of recent James Cook Research Fellows who have opted to remain in New Zealand for all or most of their Fellowship reflects the fact that although the funding may be sufficient to maintain a Fellow in New Zealand, it does not cover the escalating cost of working in an overseas university or institution. If the benefits of this Fellowship are to be maximised it is vital that future Fellows are encouraged to travel overseas, by providing a larger stipend to account for the varying fortunes of the New Zealand dollar, and the increased cost of living overseas.

After a funding increase for the scheme was declined by MoRST, and with the wish to increase the annual stipend of the fellowships to $110 k (GST inclusive) plus $10 k expenses for Fellowships awarded for 2004, the ToR have been amended so that at least five (rather than six) Fellowships are in operation at any one time. Because of the increased stipend, and no extra funding, there is unfortunately no money available to allow one-year extensions to existing Fellowships, although there is demand for extensions. Without additional funding it looks unlikely that any more third-year extensions can be approved for the next 2–3 years.

SCIENCE, MATHEMATICS AND TECHNOLOGY TEACHER FELLOWSHIPS

1 Overview

Purpose and Objectives

The New Zealand Science Mathematics and Technology Teacher Fellowships offer primary and secondary teachers of the sciences, mathematics, social sciences and technology the opportunity to improve their teaching through experience in technological or scientific practice. During their fellowships, teachers fully immerse themselves in the discovery of knowledge or the transformation of it into useful products or systems, and they become more skilled in communication of science and technology.

Scope and Scale

The New Zealand Science and Technology Teacher Fellowship scheme is currently funded at $3.43m per annum, including a contribution of $750k from the Ministry for Economic Development.

The scheme has grown, and the number of Teacher Fellowships awarded has increased from 17 in 1994, to 58 in 2003. The success rate of applications peaked in 2000 when the fund size was increased dramatically, but thereafter more applications were received each year, causing the success rate to fall to just under 50% (Figure 10).

There were 120 applications for 58 Fellowships in 2003

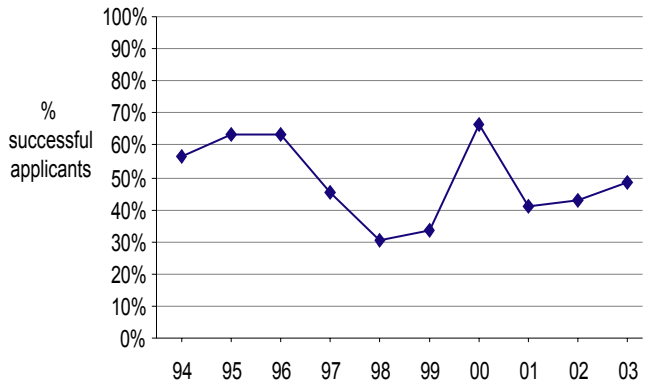


Figure 10. Success rates of Teacher Fellowship applications, 1994-2003.

Providers, Users, and Beneficiaries of the Scheme

Hosts

Practicing teachers carry out the work in each project, supported by host organisations. The host organisations for 2003 included:

- universities;
- polytechnics;
- crown research institutes;
- Government Ministries;
- Museums;
- Iwi;
- Private sector organisations;
- NGOs, and;
- primary industry.

Characteristics of Teacher Fellows

Teacher Fellows may be from primary, secondary or composite schools; they may be from state, state-integrated or private schools, and there are no quotas currently in place regarding geographic area, decile of school, gender, etc. As shown in Figures 11 and 12, for 1994-2003 Teacher Fellows, primary school teachers are under-represented in comparison to the New Zealand teaching population as a whole (Figure 11), and within the population of secondary and composite Teacher Fellows, women are under-represented (Figure 12). The Society has made efforts to redress this imbalance, and this has been paying-off, resulting in approximately equal numbers of male and female Teacher Fellows in more recent years, and about a quarter of more recent Teacher Fellows are from primary schools (Appendix V). While progress has been made, the Teacher Fellow population is still not quite representative of the New Zealand teacher population, however. As outlined later in this report, we are actively addressing issues that discourage primary school teachers from making applications.

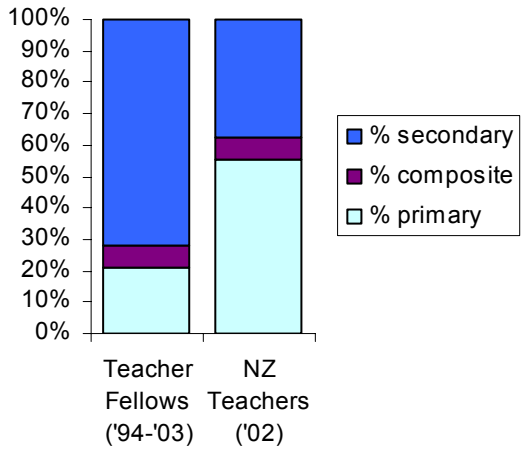


Figure 11. School type distribution of Teacher Fellows, 1994-2003, compared to that of all New Zealand teachers (Ministry of Education teacher statistics, 2002)

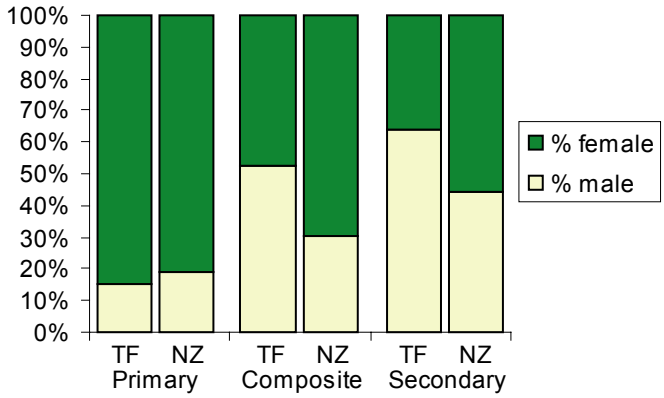


Figure 12. Gender of Teacher Fellows (TF) versus New Zealand teachers (NZ), broken down by school type.

We find no apparent bias in the socioeconomic decile ratings of the schools from which Teacher Fellows come. Thus, the scheme does not discriminate against teachers from low decile schools.

Likewise, we find that the geographic spread of Teacher Fellows is approximately representative of the geographic spread of the New Zealand teaching population (Appendix V).

2 Highlights

Some highlights of the scheme, for 2002/2003:

John Watson - One aircrew, one country: experiences and legacies 1941-1944

John teaches Social Studies and History at Glenfield College in Auckland. In 2003, hosted by the Museum of Transport, Technology and Social History in Auckland, he carried out research into a Bomber Command crew with the Mediterranean Allied Strategic Air Force. John's uncle was a member of this crew, and he wanted to find out their fate.

During his research, John interviewed many relatives of the crew members, and his research resulted in the publication of a book: *"The Forgotten Men"*

During a visit to the War Records Office at Kew, London, John met with Deric, the brother of one of the crew. Deric later wrote:

"You can imagine my utter astonishment when I was contacted several months ago by a Mr John Watson from New Zealand informing me that for the past year or so he had been trying to contact members of my family ... John informed me of the quest he had undertaken and I immediately gave him all the support I could and flew out to your wonderful country to meet him. I think it fantastic that the Royal Society of New Zealand should support such projects, and your much enlightened approach needs to be applauded. I was very moved by John Watson's book on the crew my brother flew with. His attention to detail and the depth of his research was tremendous. A real labour of love."

Stephen Lawrence - Sedimentation and ecology in East Coast waterways

Steve taught Science at Gisborne Girls' High School. Hosted by NIWA, during his Fellowship he investigated the ecology of sedimented streams of the Poverty Bay. As well as conducting research, Steve worked with the Earth Centre to develop a community project to raise awareness of storm-water in Gisborne. His subsequent successful application to the MfE Sustainable Management Fund has resulted in a public awareness campaign educating people about practices that affect storm water and its management.

Steve strongly endorses the Teacher Fellowship scheme, saying:

"I have been reassured about a range of my inter-personal skills developed as a teacher and transferred when interacting with hosts, public and government agencies. I have surprised myself at how self-motivated I am and able to independently maintain progress over a long time. I have missed the company of students and teaching colleagues."

Keri Parnell - Dynamic Beaches: Natural & Human influences on Beach Change

Keri teaches year 1-2 children at Orakei School, Auckland. She is spending her Teacher Fellowship year investigating beach processes with the Auckland Regional Council. She has compared and contrasted interactions between terrestrial and marine processes in sheltered harbour and open ocean environments. Keri includes school pupils in her work, in activities ranging from Year 1-3 children expressing the effects of storms on beaches through drama, to older children collecting and interpreting data on the movement of sand on open ocean beaches.

3 Progress and Achievements Evaluation

Achievements of the programme have been demonstrated by the review by Jordan and Galt[1], the comments above and can also be seen in the high level of continuing involvement and contributions by previous teacher fellows to the wider science and technology sector.

Knowledge Dissemination by Teacher Fellows

Teacher Fellows develop many links with their communities, and as part of reaching out to the community they do a vast amount of knowledge dissemination, and often get involved in curriculum and qualifications developments.

In 2003:

- present and past Teacher Fellows presented 32 workshops and seminars at seven conferences (for teachers of Mathematics, Biology, Chemistry, Physics, Social Studies, Technology and for laboratory technicians);
- two books were published;
- many curriculum resources were developed;
- one past Teacher Fellow directed (and continues to direct) a Ministry of Education ICT professional development contract in the Hutt Valley;
- two past Teacher Fellows were involved in other Ministry of Education professional development contracts;
- three Teacher Fellows were technology advisors to schools;
- one Teacher Fellow was a Curriculum Facilitator with the Ministry of Education, and;
- six Teacher Fellows underwent Environmental Education Facilitator training.

Tracking of past Teacher Fellows; what are they doing now?

Tracking of the 1994-2001 Teacher Fellows was reported fully in our 2002 Progress and Achievements Report. We found that, with the exception of year 2000 Teacher Fellows, attrition of former Teacher Fellows from the profession was not significantly higher or lower than overall New Zealand teacher attrition rates. We also found that almost without exception, those who had left teaching were still contributing to the education sector, often in highly creative and entrepreneurial ways, reaching many more students than can be reached by classroom teaching.

We continue to track our former Teacher Fellows.

Of the 48 Teacher Fellows from the 2002 academic year, 82% returned to the classroom. A comparison within national teacher attrition rates is not yet available, but based on older statistics, it is likely that for 2002 Fellows, attrition is slightly higher than national teacher attrition rates. However, of the 9 teachers who did not return to the classroom:

- three took positions as Advisers or Facilitators with Colleges of Education;
- two now lecture in tertiary institutions;
- one is teaching in a Private Training Institute;
- one took maternity leave;
- one retired from teaching; and
- one has started her own business in the fashion industry.

Thus, 45/48 (94%) of the 2002 Teacher Fellows continued to contribute to the education sector, as teachers, lecturers, or College of Education advisors.

[1] Jordan, S. and Galt, N. 1999 The Science and Technology Teacher Fellowship Scheme: An Evaluation; Education Department, University of Canterbury, New Zealand.

4 Policy Implications and Future Investment Priorities

Encouraging Applications from under-represented areas

There are still a number of factors that continue to present barriers to a teacher making application, such as:

- the nature and intensity of the current work-load of teachers – teachers are focused on their students and their school and any activity outside of this receives low attention;
- a dire shortage (especially in the case of Māori speakers) of replacement teachers – Boards of Trustees will not release teachers unless satisfactory replacement teachers are available;
- a reluctance by some Principals to allow the release of teachers from their school (because of the difficulties of finding a suitable replacement);
- a continuing (but diminishing) lack of awareness of the programme by teachers;
- a perception, particularly by primary teachers, that they are not qualified to put forward an application; and
- difficulty for teachers in finding appropriate hosts.

The first three factors are beyond the control of the Society, but we actively address the fourth and fifth through promotion of the programme and support provided to applicants by Society staff and previous teacher fellows. The sixth factor will be further addressed by the initiation in November 2003 of a "Sits Vac" web page where teachers may gain ideas for Fellowship projects. Brief outlines of potential projects from prospective hosts will be posted on this page to stimulate potential applicants and broker relationships between applicants and hosts.

We will also be introducing a preliminary application phase where those who have the germ of an idea may present it and RSNZ staff will comment and make further suggestions to the applicant.

Primary teachers are those most inclined to feel that they are not worthy of applying or that they do not fit the criteria. Because they are generalist teachers rather than specialists, this presents extra challenges for their applications. In particular, it makes it difficult for them to identify suitable activities or hosts. This situation has improved as a result of requiring Teacher Fellows to visit schools and give presentations on the scheme, but we believe that more can be done to encourage primary teachers to apply.

In order to address the identified under-representation from primary teachers and Māori/Pasifika teachers, we suggest that a minimum of 20 Fellowships (45%) should be targeted to primary teachers in an attempt to convince them that these Fellowships are indeed for them, and similarly we suggest that 6 (14%) of the Fellowships be targeted to Māori/Pasifika teachers. We believe that the target of 20 Fellowships for primary teachers requires no additional funding, and we offer three of the proposed six Fellowships for Māori/Pasifika from the current allocation.

Aligning Teacher Fellowships with the Growth and Innovation Framework

There is currently an opportunity to align some of the Teacher Fellowships with the Growth and Innovation Framework. While it would be against the philosophic basis of the scheme to target all Teacher Fellowships to specified sectors, some could be targeted towards the three sectors identified for growth and development, namely biotechnology, ICT and creative industries. Within the current untargeted nature of the scheme, we do fund some fellowships in these areas (Table 7), but there is scope for further alignment with GIF.

Table 6. Number of Teacher Fellowships funded in GIF areas, 2002-2004

GIF area	2002	2003	2004	Total 2002-04	% of Fellowships 2002-04
Biotechnology	4	8	2	14	29%
ICT	2	1	5	8	14%
Creative Industries	3	2	4	9	15%

As the Ministry of Education has recently announced a suite of 12 e-learning Fellowships which are similar to Teacher Fellowships, but targeted to the ICT area, we suggest that we do likewise for biotechnology, electronics and creative industries, and target 12 Fellowships for each area.

We are in favour of targeting biotechnology, creative industries and electronics because schools find these to be difficult areas to deal with. Although biotechnology and electronics are in the technology curriculum, they are most often taught by teachers with academic science backgrounds and qualifications. These teachers often have limited practical experience, a limited understanding of the principles of the technology curriculum, and consequently experience difficulty in teaching this area in the spirit required for tomorrow's world. Experience in current biotechnological or electronics practice will provide them with understanding and skills which they will take back to the classroom and their students. It will also enable them to undergo the paradigm shift required to move from being a biology teacher to a teacher of biotechnology or a physics teacher to a teacher of electronics.

Creative industry is a different issue again, although the element of disconnection between background experience and the spirit and requirements of current curricula is common. Creative industry is encompassed in both *Technology in the NZ Curriculum* and *Arts in the NZ Curriculum* and we again find that many teachers face difficulties in teaching these areas to the spirit and requirements of the future. For the same reasons as above, we suggest targeting this area to enable teachers to gain current experience in these creative areas which they are able to take back to their colleagues and students.

We seek a change to the terms of reference of the scheme to enable the targeting of particular areas, and in order to still allow sufficient awards in topics outside the GIF areas, we further seek an increase of 12 Fellowships to the Fund. This would increase the target number of Teacher Fellowships each year from 45 to 57, and with an additional three Fellowships targeted to Māori/Pasifika teachers (as outlined above), the total would increase to 60.

Involving Teacher Fellows in Professional Development of other Teachers

When we negotiate our 2004-05 Output Agreement, we will further be requesting a change in the terms of reference for the scheme to enable teacher fellows (current or past) to be supported by the Fund to provide pre-service and post-service professional development for colleagues in a formal sense. This could be by:

- acting as mentors for trainee teachers;
- mentoring colleagues from nearby schools; or
- providing traditional in-service courses for colleagues.

In each of these situations, the dissemination of the knowledge, skills and understandings gained during the Teacher Fellowship experience will be magnified greatly.

A series of in-service courses given by exemplary Teacher Fellows in areas of high interest will again be organised for Terms 1-2 of 2004 to further facilitate promotion of the scheme as well as dissemination of information and skills to teachers. This year we intend to enlist the assistance of the professional subject associations to manage these in order to gain even greater exposure of the Teacher Fellowship scheme.

RSNZ Contract Management

We seek an increase in the contract management fee to enable us to

- work with the biotechnology and creative industries sectors to generate sufficient opportunities for Teacher Fellowships and to widely promote these opportunities to teachers,
- more effectively promote the scheme to Māori/Pasifika teachers by travelling to key areas to present the scheme to Māori/Pasifika teachers; and
- facilitate even greater dissemination of the learnings of individual teacher fellows to their colleagues.

These changes will increase the number of teachers informed by the Teacher Fellowship scheme and so contribute to a heightened interest and awareness of the biotechnology and design sectors, and potential careers, in European, Māori and Pasifika school pupils which will contribute to future capacity and capability in these areas. There is well documented evidence that changes in teaching practice take time and long-term support to become embedded. For this reason, we strongly defend the case that Teacher Fellowships be a full year if at all possible. Changes in attitude and skills need continued support in order to ensure that the individual does not regress to previous learned states. We propose to use Teacher Fellows to provide a series of in-service courses for colleagues. This will provide stimulus and support for the move to the knowledge society, particularly in the strategic areas of sciences and technology. In the longer term, our suggestions will show a positive impact on New Zealand's future human capability.

The NZ Science Mathematics and Technology Teacher Fellowship scheme undoubtedly fulfils all expectations of fellowships, and is a flagship activity for the New Zealand Government. It contributes significantly to the economic, social and environmental future of New Zealand by:

- rewarding outstanding performance;
- promoting a science and technology culture;
- advancing professional careers;
- building current and future human capital; and
- enabling the production of useful outcomes, especially encouragement and stimulation of young people in science and technology.

PROMOTING A CULTURE OF INNOVATION

The Society is one of a handful of agencies that promote awareness and understanding of the value of science, technology and innovation. Initiatives by other agencies include science and technology museums and centres, a number of local and national programmes for youth enterprise, the Dunedin International Science Festival, local science fairs, and university science days.

At the national level, the Society carries out many activities under its own mandate as an independent science and technology agency, as well as activities supported by MoRST. Under the general rubric "Promoting a Culture of Innovation", the Society places science personalities on radio, in public meetings and in print media. The Society's most recent survey of press coverage showed that, of the 150 or so science articles published by New Zealand newspapers each month, about one third are stories seeded from information put out by the Royal Society. The Society is also very active in schools, with its CREST, BP Challenge, and Science Fairs. These activities bring in some $240,000 from the private sector. The Ministry of Education funds a number of programmes for science and technology teachers, as well as the National Waterways Programme. Lastly, the Society administers a $1.7 m "Enterprise Culture and Skills Activities" fund for Trade and Enterprise.

MANAGEMENT OF THE SCIENCE AND TECHNOLOGY PROMOTION PROGRAMME

1 Overview

Within the MoRST-funded Science and Technology Promotion programme administered by the Royal Society, are two schemes:

RSNZ Communicators Programme

- **goal***:* increase direct interaction between scientists and the public;
- **activities:** young scientists are trained in communication and media skills, and then linked to community organisations and to the media, who call upon them for talks and interviews. A programme of "prestigious" speakers is also run, in which top scientists give public talks around the country.

Masterclass!

- **goals:** to expose New Zealand scientists to top international researchers and to promote science to the public;
- **activities:** Masterclass is a non-government inititiative. Organized in conjunction with Fulbright NZ, British Council New Zealand and Montana Wines, a complementary pair of US and UK scientists are brought to New Zealand for a series of academic, specialist and public seminars.

Although not formally a part of the Management of Science and Technology Promotion Programme, we also report on events organized for the celebration of the ***50th Anniversary of the Discovery of the Structure of DNA***, which was seeded by a one-off grant from MoRST. A number of the Masterclass and Communicators programme activities were organised under the umbrella of the 50th Anniversary celebrations.

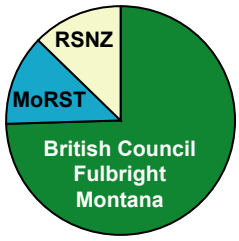
Scope, Scale and Leverage of Funds

RSNZ Communicators Programme

- In the 02/03 financial year, the Royal Society organised four communicators courses, training a total of 48 scientists in Christchurch, Palmerston North and Auckland (two courses). The courses were fully funded by Vote RS&T in 02/03.
- Government funding has now terminated, and RSNZ will endeavour to continue this highly worthwhile programme on a user-pays basis.

Masterclass!

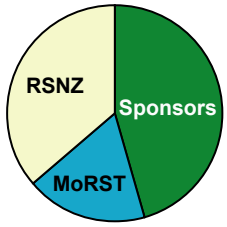
- The Royal Society undertook the majority of the organsation of two Masterclass programmes, the first in August 2002 on *climate change and energy*, and the second in June 2003, on *genomics*.
- MoRST provided $10.0 k to support these activities from Vote RS&T funds. The Royal Society contributed a further $10.0 k, and the majority of the funds ($60.0 k) were contributed by the British Council, Fulbright, and Montana Wines.
- In addition to the direct financial support, there was much in-kind support from other organsations, in particular those hosting talks.



Funding Sources for Masterclass

DNA 50th Celebration

- The Royal Society was able to achieve enormous leverage from Vote RS&T seed funding for the DNA 50th activities. The government contribution of $20.0 k was multiplied many times over by contributions from sponsors who provided direct monetary support and a great deal of in-kind support.
- The Royal Society organised around 30 events and talks under this theme, and more are to come in the second half of 2003.
- MoRST provided $20.0 k seed funding; the Royal Society contributed $40.0 k, and a further $50.0 k was raised in direct cash contributions from a number of sponsors.



Funding Sources for DNA 50th Celebration

2 Highlights

RSNZ Communicators Programme

The feedback from course participants and from community groups who have used the communicators has been highly complimentary. We have 154 excellent speakers giving community talks, making choosing a highlight difficult. Here we highlight just one speaker's activities:

Katja Riedel is a young atmospheric scientist at NIWA, who works on greenhouse gases and climate change, and who has spent 15 months in Antarctica. She is passionate about improving communication between scientists and the public, and is keen to share her enthusiasm about natural science, and her experiences in Antarctica. Katja attended a Communicators workshop in January 2002, and subsequently prepared three talks:

- Greenhouse Gases and Global Warming – what you always wanted to know but were afraid to ask.
- Living the Dream – 15 months in Antarctica
- Digging Deep in the Middle East - Archaeology and adventures in Jordan, Syria and the Lebanon.

To date she has given eleven talks under the communicators scheme, to:

- the Kenepuru, Eastern Hutt, and Newlands branches of Probus;
- the Lower Hutt and Epuni branches of the Lions club;
- the Antarctic Society;
- the Tararua Tramping Club;
- the Wairarapa Geological Society;
- the Eastern Suburbs University of the 3rd Age; and
- the general public at Te Papa.

We have received the following feedback from groups that Katja has talked to:

"Although our request was made at short notice we contacted Dr Katja Riedel at NIWA who was only too pleased to come out to speak at our meeting earlier this week. She spoke on her time at the German station in Antarctica and everyone at the meeting found her to be very interesting and a great person to have with us. I have had very positive feedback and we will very likely ask if she would be prepared to visit again and speak on one of her other topics."

"Today we had an exceptional talk from Katja Riedel of NIWA on "Life and Science in Antarctica". We were greatly impressed by Katja's presentation and her youthful exuberance. Her coloured slides were magnificent."

Katja continues to play an active role in the communicators programme.

Masterclass!

The impact of Masterclass was immense: a total of 21 talks and fora were delivered to an estimated total audience of 1700. Of that total, over 1,000 scientists attended the Masterclass seminars and the public lectures were well-attended. In the case of the *climate change and energy* Masterclass, seminars for business people were also held, and the two *genomics* Masterclass experts spoke to student groups about careers in science. Extending their reach still further, both of the Masterclasses attracted comprehensive national and local media coverage, for example, geneticist Dr Neil Hall was interviewed by Kim Hill on 14 June, with an estimated audience of 300,000.

DNA 50th Celebration

Major benefits flowed from organising events under the umbrella theme of the DNA 50th. Namely:

- a great number of different parties became involved with the activities and collaborated to organize events;
- the theme acted as a catalyst, motivating others to stage events that were in-line with the theme;
- the media impact was greatly boosted; and
- the "celebrity factor" (Maurice Wilkins, and the high profile Masterclass speakers) proved to be highly successful in generating media interest and engaging people in the topic of genetics.

3 Progress and Achievements Evaluation

Amount of Activity

RSNZ Communicators Programme

- The Royal Society organised four courses, training 48 young scientists;
- 154 speakers who are willing to talk to the general public on request are now on our continually checked and updated database;

- 125 talks have been organised as a part of this programme;
- 21 connections between speakers and community groups have been made directly through the database this year;
- The Royal Society produced and sent a brochure promoting the scheme to community and professional groups. This resulted in a steady number of requests, all of which we have been able to satisfy; and
- In Christchurch, the organisation of talks was subcontracted to a very successful outreach programme already existing at the University.

Masterclass!

- 12 academic seminars;
- 4 public lectures;
- 3 business seminars, and;
- 2 careers sessions for students.
- In total, 1700 attendees

DNA 50th Celebration

The DNA 50th celebration was developed as an umbrella theme under which a number of the Masterclass and Communicators Programme activities were organised. In addition to those already covered above, further activities under this theme were:

- An afternoon reception at Government House to launch the campaign;
- A public lecture by, and launch of booklet on, Professor Alan Cooper: a New Zealander now based at Oxford University, who led the first team in the world to determine the complete mitochondrial DNA sequence of the Moa;
- The DNA 50th lecture tour by four leading New Zealand scientists;
- The Royal Society commissioned a painting of New Zealander, Maurice Wilkins, which was reported on TVNZ and unveiled in London and Wellington to celebrate his role in the discovery of the structure of DNA, and Victoria University of Wellington unveiled a plaque commemorating the event;
- The Royal Society developed a DNA 50th website, including DNA articles and a map of DNA research in New Zealand: www.rsnz.org/news/dna50;
- New Zealand's only science billboard was erected by the RSNZ, and has featured several DNA-related skins;
- A special DNA 50th anniversary issue of the *New Zealand Science Review* was published, sponsored by the Royal Society and the Marsden Fund;
- The Society, in conjunction with sponsors, produced a series of several thousand DNA 50th postcards, distributed at lectures, to teachers, CRIs and museums;
- Trade New Zealand used Royal Society materials produced for DNA 50th, for their roadshow that toured Australia promoting their new biotech brand: "Biosphere";
- Museums in Palmerston North, Auckland and Dunedin mounted special exhibitions and talk series on the DNA 50th theme, using our speakers;
- The Allan Wilson Centre for Molecular Ecology and Evolution ran a series of lectures, collaborating with the Royal Society;
- Victoria University ran a continuing education series in association with the Royal Society on DNA and genes; and

Media Coverage

Extending their reach still further, Masterclass and DNA 50th events gained a great deal of media coverage via newspapers, radio and television. They are listed below.

Radio:

- 1ZB
- Nine to Noon
- Chris Laidlaw's Sunday programme
- 6 Eureka Science Programme features
- Environment Matters
- 5 Kim Hill interviews
- 2 Morning Report features
- Various local radio programmes

Television:

- Breakfast television
- Local television
- 3 TV One News items
- The Holmes Show

Newspaper and Magazines:

Masterclass and DNA 50th generated many articles, in:

- NZ Herald
- Christchurch Press
- Otago Daily Times
- Dominion Post
- Manawatu Evening Standard
- *New Zealand Science Teacher* and other specialist magazines

Feedback on the RSNZ Communicators Programme

The feedback from course participants has been overwhelmingly positive, participants commenting that the most beneficial aspects of the course were:

- its practical nature; participants did mock radio and television interviews, and wrote media releases;
- the performance feedback received – most had never heard or seen themselves speak before;
- the group experience: linking with other scientists passionate about communication; and
- the motivation and confidence gained, enabling them to "get out there and do it".

"It is probably one of the best skills that I've been taught. I thoroughly enjoyed the whole workshop, and as a result am even more motivated by the idea of science communication to the public! This is definitely a career option I'll be considering, if opportunities beckon. I was especially glad to be able to share this enthusiasm with other people in the group, many of whom I share the same aspirations with."

"I found every aspect of the course useful – from the practical issues of dealing with the print media, radio and television, to the strategies for giving an effective presentation. It was also

useful being with a group of people from such diverse disciplines and backgrounds. It helped us look at our research in the context of the greater knowledge as well as allowing us to share different strategies for dealing with the media and public."

A great deal of positive feedback has also been received from community groups, commenting on the speakers' enthusiasm, preparedness, and the fascinating insights gained from their talks.

4 Policy Implications and Future Investment Priorities

In the light of the success of the DNA50 theme this year, the Ministry has agreed to provide funding for bringing overseas speakers to New Zealand and organising the media promotion of them. The Royal Society has already leveraged considerable support from non-government funds for these activities.

This is the area where the Royal Society recommends that funding be directed in 2004/5. We have found these visits and the resulting media to be extremely effective; visits by Lord May, Alan MacDiarmid and by speakers for the DNA programme have demonstrated this over the last two years. The Society is able to attract considerable financial support from other sources, but sponsors invariably want to pay for the tangible, visible things, not Society administrative time. We have shown over the last two years that, with MoRST investment in the Society's planning and labour to initiate and organise tours and promotions, we can multiply the investment many times over by leveraging other contributions. The Society is in a unique position, in that it is the only scientific organisation in New Zealand that is able to nucleate this kind of coordination and collaboration between agencies.

Feedback gathered to-date on the Royal Society Communicators scheme has been very positive, both from course participants and from the community groups they have interacted with. The course is highly valued by participants in terms of what they learnt, and the motivation and confidence they acquired. The feedback from community groups using the communicators has also been extremely positive. The Society considers continuing this scheme to be highly desirable, but as there is no further government funding available, we will continue it on a user-pay basis, relying on participants or their employers to pay the course fee. Three courses are planned for the second half of 2003, and we are collaborating with FRST to promote the course to prospective participants. The Society's own prestigious speakers programme will support the Transit of Venus promotion in the first half of 2003.

CONTESTABLE FUND FOR SCIENCE AND TECHNOLOGY PROMOTION

1 Overview

The principal objective of the Contestable Fund for Science and Technology Promotion is to promote positive values and attitudes towards science and technology at all levels of the New Zealand community. Grant recipients are encouraged to use it as seed funding to enable additional funding to be raised from other sponsorship areas. Projects are selected on various criteria, the most important being that they promote the value of science and technology in interesting, creative, exciting or innovative ways to an audience which is not already showing a strong interest.

Scope & Scale

The size of the fund was constant at $400 k from 1998 until 2002. In 2003, an extra $20 k was allocated to the fund, bringing the amount of funding granted in the 03/04 selection round to $420 k.

In the 2002/03 funding round, 9 projects were funded from a total of 68 applications, with bids totalling $3,828,989. This means that the success rate has now dropped to 13%, continuing the downward trend since 1999 (Figure 13). The number of applications has increased slightly since 1999, and in addition the number of grants awarded has decreased and their average value has increased (Figure 14). The increase in grant size has been particularly marked in the 2002/03 funding round, when, for the first time, the $30 k funding cap that was applied to all but one grant per year was lifted. This change was made in response to recommendations from a review of the fund in March 2002, and it has had the positive effects of curbing artificial inflation of budgets to the $100 k and $30 k limits, and allowing the fund to make grants that more realistically provide for project costs.

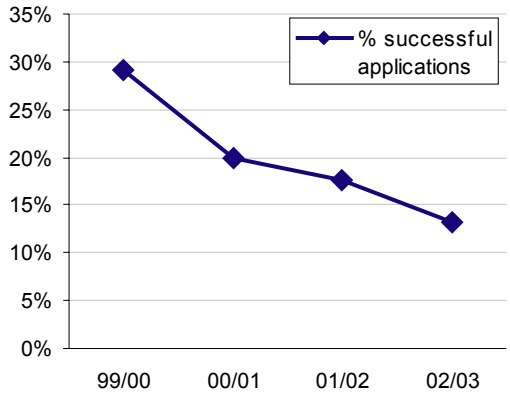


Figure 13. The success rate of applications to the Science and Technology Promotion Fund

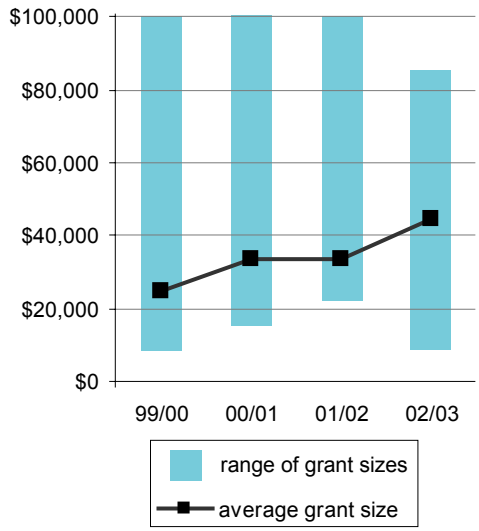


Figure 14. Size of grants from the Science and Technology Promotion Fund

Providers

Providers may be from any institution, individual or group, excluding the Royal Society and the Carter Observatory. In each of the past two funding rounds there has been a good spread of projects across different providers.

Provider	01/02	02/03
Professional Society/Interest Group	1	3
Charitable Trust	3	2
Private Sector	1	1
University	3	1
CRI	0	1
Museum	3	1
Student Association	1	0

Users

Projects must demonstrate that they will reach an audience that is not already showing a strong interest or understanding of the value of science and technology in achieving success and wellbeing for New Zealand. The table to the right shows the number of projects from the 01/02 and 02/03 funding rounds that targeted particular groups.

Target Audience	01/02	02/03
Children	1	4
Teenagers	2	2
Adults	2	2
Parents/Caregivers	1	2
Teachers	2	2
Māori	4	2
Pasifika	2	2
Business	2	0
Entire Community (not specifically targetted)	3	3
Total # Funded Projects*	12	9

* Because most projects were aimed at more than one audience, the sum of projects targeted to different areas is greater than the total number of projects.

2 Highlights

Noteworthy contracts funded in 2002/03 include a science programme for children and care-givers at Otago Museum which was so popular the organisers had to find a new venue and more staff to cope with the demand, a beautiful full-colour calendar featuring young scientists from all backgrounds who will provide excellent role models for our young people and a complete and working New Zealand

version of Stonehenge being built in the Wairarapa for young and old to explore how ancient technologies were used to give information on the seasons, time and navigation.

Particularly successful is ***Summer of Discovery:*** production of a video and accompanying activity book full of fun experiments, field trips, and adventures to excite and inspire children and caregivers about science and technology. The video, due for summer holiday release, is presented by Jason Gunn and his animated sidekick "Bob the Blob" who, together, show that science is fun and a part of our everyday lives. The video will be available for a $2 week-long hire from VideoEzy stores, and a free copy of the activity book will accompany every rental.

The project leader has been outstandingly successful in gaining extra sponsorship, with contributions from the VideoEzy Charitable Trust, Brian Mason Scientific & Technical Trust, and Heinz Watties. Support in the form of promotion will be provided by TVNZ and IDG, and a Bauer bike has been donated as a prize.

Although the major promotional push will be timed to coincide with the beginning of the summer vacation, the project has already received media attention in the Christchurch Press, and an article in the parenting section of Women's Weekly is planned. This project is shaping up to be a great success – watch out for the video this summer!

3 Progress and Achievements Evaluation

Projects funded in 2002/03 comprise a museum science programme for children and their caregivers, science inserts into breakfast cereal boxes, a fun and educational science video, an educational Stonehenge 'replica', Robotic Olympics, interactive community exhibitions, a mentoring scheme, a calendar for schools, and a promotion of the practical value of science in the garden. For a fuller description of the projects funded in 2002/03, and their progress to-date, see Appendix X.

How many people are reached?

The Society has collated estimates of the number of people reached by the 9 projects that were funded in 2001/02, which have now been finished (3 are still ongoing). The following are minimum estimates only; most of the projects are ongoing, and many have a wider impact beyond the direct participants counted (e.g. students of the teachers who attended workshops).

- 110 business people attended regional fora promoting the value of S&T to SMEs;
- 107 teachers attended workshops on "the language of our rocks";
- 1600 people attended fun science demonstrations in South Auckland shopping malls;
- 83 Māori attended Marae-based science and technology wananga;
- 92 school students were mentored;
- 7200 visitors to the Lyttleton Timeball Station watched an explanatory video; and
- 25,200 viewers for each "Minute of Science" segment showed on Knowledge Breakfast TV (four different segments were each screened twice).
- **34,392** Total minimum audience

In addition to the above, two projects had no direct audience during the course of their funding, but both are expected to have a wide reach in the future. One produced a classroom resource showing the passion, creativity and inspiration of scientists, and the other produced mobile interactive exhibitions, for which 10 display venues have now been booked.

Geographic Coverage

Every year, the selection panel endeavours to select projects that provide a balanced geographic coverage. This table shows the geographic coverage of projects selected in 2001/02 and 2002/03. The largest class of projects are national in coverage, with the majority of regional projects based in Auckland, Wellington, Canterbury and Otago. While this provides coverage of the main population base, we find

	01/02	02/03
All New Zealand	3	4
North Island	-	1
Auckland	3	
Wellington	1	2
Wairarapa	-	1
Canterbury	1	-
Otago	1	1

that there are few projects at this time that target more remote regions.

Media Coverage

Some projects generate a great deal of media coverage, extending their reach beyond the direct participants in a programme. Even though most are not yet complete, projects funded in 2002/03 have to-date seeded 20 newspaper articles and 2 articles in specialist journals; we anticipate more coverage to come. Some providers appear to be better at generating media coverage than others, and the Society is considering ways in which media coverage of the less visible projects could be increased.

4 Policy Implications and Future Investment Priorities

The Science and Technology Promotion Fund delivers excellent value for money and is often used by grantees to leverage additional commercial sponsorship monies. A wide cross-section of the community is reached by the funded projects, and the spread of the projects across the country ensures this impact is nationwide both in terms of the community and media

Following the success of the DNA50 programme (run by the Royal Society) which has covered major centres across New Zealand throughout 2003, we have seen the effectiveness both economically and promotionally, of tying in a large number of projects under one banner or theme. Further investigation of this method could lead to an increase in the effectiveness of the monies from the Science and Technology Promotion Fund.

Each year the variety of imaginative projects to apply for funding is large but the bids amount to ten times the available funding. In addition the removal of the $30,000 cost limit has enabled the Fund to give larger awards but consequently fewer projects are successful in gaining funding. Although this has enabled stronger, more effective projects to proceed, the number of disappointed applicants has risen still further. A review of the Fund in March 2002 noted the level of dissatisfaction among applicants at the continuing low level of funding for the promotion of science and technology. This situation has worsened since that time, with the success rate continuing to drop. The Royal Society fully supports the initiative by MoRST to provide funding for a sponsorship programme (in 2003/04) to encourage projects not in receipt of Promotion Fund awards to gain commercial sponsorship. However, we also strongly recommend the Fund be increased by at least $200,000 (an increase of $20,000 was received in 2003/04).

FOSTERING TALENTED YOUNG NEW ZEALANDERS

1 Overview

The Royal Society's goal in fostering talented young New Zealanders is to enthuse, excite and motivate young people in science and technology. We see this as an important contribution to strengthening New Zealand's future capacity in S&T. In addition to identifying, communicating with, and organising events for young achievers, we make it possible for them to travel to international science and technology events. This develops in our young achievers an outlook that is global rather than parochial, and builds the foundations for full New Zealand participation in the global community.

We foster talented young New Zealanders through a variety of schemes, some contracted by MoRST, and others sponsored by non-government sources, such as the BP Challenge. We support additional activities through our association with the NZ Association of Science Educators, Technology Education NZ, and other professional teacher associations.

The activities currently contracted by MoRST are:

- Identification of and communication with young achievers;
- Selection, administration and gaining of sponsorship for young achievers to participate in and learn about international research and develop links with international researchers and students; and
- Development and coordination of a national celebration and promotional event in December 2003 for high achieving school students in research and technological practice. This event is now known as *"Realise the Dream"*.

Scope & Scale

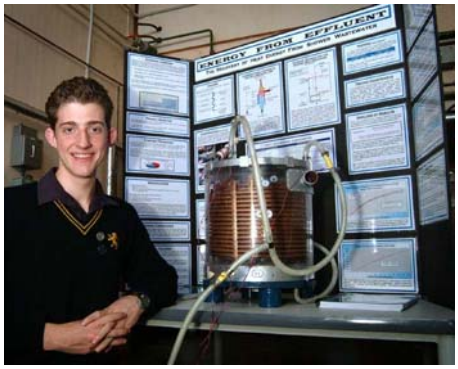
For the above three activities, MoRST provides administrative funding with which we have been able to leverage further from sponsors, comprising:

- Travel support for young people to attend international S&T events (sponsors include Asia2000, BRANZ and the British Council);
- External sponsorship for *Realise the Dream*. The major sponsor of *Realise the Dream* is Genesis Energy Ltd, and there is also support from Dexcel, Victoria University, and 8 other organsations who sponsor awards.

2 Highlights

Significant media coverage is generated by the young achievers, particularly in community newspapers but also on radio and television. This helps to extend the scheme beyond the talented young New Zealanders and into communities, promoting the value of science and technology and the opportunities available.

One of our most talented young New Zealanders is Haydn Luckman. Haydn achieved a Gold CREST Award and participated in 3 National Science and Technology Fairs, winning a merit award in 1999, and the Premier Award for Technology in 2002 for his study on recovering heat energy from shower wastewater. His success generated a lot of media attention, and he appeared on the Holmes Show and on TV One news. Haydn was sponsored to attend the London International Youth Science Forum, and wrote:



"The forum gave me a new insight that has changed the way I look at the world and its people. I now have a sense that we are all citizens of the world, no matter where we choose to live. The LIYSF was a total success"

Haydn graduated from Auckland Grammar School at the end of 2002 with an A Bursary and is now studying engineering and commerce at the University of Auckland.

3 Progress and Achievements Evaluation

Identifying and Communicating with Young Achievers

Our database currently holds information on 699 young achievers aged from 6 to 24. They have been drawn from programmes such as the Genesis Science Forum, Science and Technology Fairs, CREST, and subject association competitions.

- *90* are at primary level;
- *284* are at secondary level, and;
- *325* are at tertiary level.

We continue to support the achievers by informing them of recent developments in scientific and technological practice and opportunities such as scholarships and competitions. We also help them to identify mentors in the science and technology communities.

The database is being further developed to provide greater functionality and to improve our ability to target particular groups of young achievers. Next year we will be able to report information such as the distribution of talented young New Zealanders geographically, and by fields of study.

International Experiences for Talented Young New Zealanders

The RSNZ currently administers selection of student and teacher participation in:

- The US International Space Camp;
- The Australian International Space School;
- Prof Harry Messels' Science School, Australia;
- The Taiwan Science Fair;
- The APEC Youth Science Festival;
- The Hong Kong Science Fair *(new for 2002);*
- The Beijing Youth Science Competition;
- The London International Youth Science Forum; and
- SEAMEO 3rd Congress, Penang.

In the 2003 school year, we supported 20 pupils and 3 teachers to take part in events in 4 countries (Australia, China, USA, and the UK). The SARS epidemic seriously affected our activities this year. One of the two students selected to the Beijing Youth Science Competition withdrew from the trip at the airport, and the APEC Youth Science Festival was postponed until 2004.

Realise the Dream

Realise the Dream is now a reality. Selection of students for the event is underway; it will be held in December 2003. *Realise the Dream* will be a week-long programme bringing together around 40 high-achievers in science, technology, social science and mathematics. The students will further their knowledge and skills, and develop an understanding of the commercial development of ideas. They will develop their presentation skills, learn about intellectual property, patents and venture capital, be engaged in future planning exercises, and learn about the work of selected organsations engaged in research and technological practice.

4 Policy Implications and Future Investment Priorities

The reception that these activities have had with young people and the benefits from the international participation indicate that this scheme is highly valuable and beneficial and that it must be continued and strengthened in the future. The new initiative, *Realise the Dream* will assist. We also welcome the establishment in the 2003/04 Output Agreement of a small contestable fund to contribute to travel

costs for students attending international events for which no travel sponsorship is available. These events include the US International Space Camp, the Australian International Space School, Prof Harry Messels' Science School, and also events for which the RSNZ does not administer the selection process such as student Olympiads, Future Problem Solving events, and other countries' Science Fairs. Currently, selected participants must pay or raise funds for the costs themselves. This fund will allow more promising young individuals to take up international opportunities. In light of our experience with the London International Youth Science Forum, applications for which increased 400% (particularly from lower socio-economic groups) when travel sponsorship became available, we fully expect demand for this fund to greatly outstrip supply. We are seeking an increase in the size of this fund.

Many activities that promote the value of science and technology take place within schools. These are implemented on a voluntary basis by teachers and others, and are reliant on goodwill and/or sponsorship for their survival, and therefore their benefits are sometimes not as great as they could be. It is within the scope of this output for the RSNZ to identify such worthwhile activities and programmes and provide management in a collective manner (CREST, Olympiads, Science and Technology Fairs, Future Problem-Solvers, YIP, etc) rather than forcing each to compete and eke out existence.

"Lectures were amazing, and had a great sweep of topics, ranging from small amino acids to large galaxies, and everything in-between. The lecturers chosen were extremely captivating people (who had an amazing and definitely valuable skill of being able to transform topics I am not usually interested in, into fascinating subjects) from which much inspiration and knowledge was drawn from. Needless to say, I enjoyed every lecture."

Tiam Maghasodi, Prof Harry Messel's Science School

NEW ZEALAND SCIENCE AND TECHNOLOGY MEDALS

1 Overview

Rutherford Medal

The Rutherford Medal is the highest award, instituted to recognise and honour those who have made exceptional contributions to New Zealand society and culture through activities in the broad fields of science, mathematics, social science, and technology. The Rutherford Medal recognises a significant contribution to the advancement and promotion of public awareness, knowledge and understanding in addition to eminent research or technological practice.

Silver Medals

Silver Medals are awarded to honour men and women who have made excellent contributions to the fields of science, mathematics, social science, and technology. Awardees must have made conspicuous long-term contributions to science, industrial research, or science education, and to the promotion of the public awareness of science, mathematics, social science, or technology. Up to 10 Silver Medals are awarded annually.

Bronze Medals

Bronze Medals are awarded to men and women who can serve as role models in Science and Technology and demonstrate the importance of Science and Technology to the community. They meet at least one of the following criteria:

- have made a single, exceptional contribution to their field;
- have made a significant long-term contribution to science, industrial research or science education; and
- have been involved in the significant advancement of, or promotion of, science, mathematics, social science, or technology.

2 Highlights

The 2002 Rutherford Medal for Science and Technology was awarded to world-renowned physicist, Professor Jeffery Tallon and presented to him by the Minister of RS&T at a function at Te Papa in November 2002.

Professor Tallon is a leading international researcher in high-temperature superconductors. These materials become perfect conductors when cooled below a critical temperature and feature in several revolutionary technologies. He has made wide-ranging discoveries in the physics, chemistry and materials science of these special materials. A former James Cook Research Fellow and Deputy Chair of the Marsden Fund, Professor Tallon's personal enthusiasm for the discipline of physics, and his passion for issues of science and society, are communicated widely through speaking and demonstrating to schools, service organisations, professional societies and the wider community.

Professor Tallon, a Fellow of the Royal Society of New Zealand, is Distinguished Scientist at Industrial Research Limited where he has worked since 1967, and Professor of Physics at the School of Chemical and Physical Sciences, Victoria University of Wellington.

In 2002, there was one nomination for the Rutherford Medal and 21 nominations for Science and Technology medals (2 in health; 1 in engineering; 12 in science; 5 in education; and 1 in mathematics). One Rutherford, five Silver and six Bronze medals were awarded. These medals were presented at various local ceremonies around the country during the last year.

3 Progress and Achievements Evaluation

Last year the Royal Society considered the suite of Science and technology medals to see if there were any gaps in coverage. The Royal Society Council agreed that a Pickering Medal for Technology should be instituted, at a slightly lower level than the pre-eminent Rutherford Medal for science or

technology and above the Government's S&T Silver Medals. The Society recommended to the Ministry that it consider adding this medal to the suite of New Zealand Science and Technology Medals and therefore that funding of the medals be increased to cover costs of striking the medal and to cover costs relating to holding an award ceremony and Royal Society administration costs.

This funding request was declined but the Royal Society has decided anyway to introduce a Pickering Medal for innovation in technology to the suite New Zealand Science and Technology Medals at its own expense. The inaugural medal will be awarded in 2004.

Discussions are under way concerning the possible introduction of Karl Popper and Joan Metge Medals in the social sciences. There is also the possibility of the Royal Society administering a Hillary Medal for Antarctic science.

SCIENCE AND TECHNOLOGY PUBLICATIONS

JOURNALS PUBLISHED BY THE ROYAL SOCIETY OF NEW ZEALAND

1 Overview

Purpose and objectives

Government supports the publication of seven New Zealand primary research journals, through an annual grant to the Royal Society. The journals are:

- the New Zealand Journal of Agricultural Research (NZJAR);
- the New Zealand Journal of Botany (NZJB);
- the New Zealand Journal of Crop and Horticultural Science (NZJCHS);
- the New Zealand Journal of Geology and Geophysics (NZJGG);
- the New Zealand Journal of Marine and Freshwater Research (NZJMFR);
- the New Zealand Journal of Zoology (NZJZ), and
- the Journal of the Royal Society of New Zealand (JRSNZ).

The Society publishes the journals with the primary objective of providing a unique and beneficial service to a large section of New Zealand researchers. Through these journals, the results of New Zealand research are synthesised, documented, and disseminated internationally to inform other researchers, and to complete the investments made in the research itself.

Science publishing is a global activity that is a keystone in the process of scientific research. The New Zealand journals published by the Royal Society are largely regional in content and scope – and while they are of unique value to the New Zealand region, they also extend to a wider audience, particularly within the Southern Hemisphere (Australasia, Japan, China, South America, South Africa and Antarctica) and the western Pacific United States. All journals are sold internationally.

A major publishing objective of the Royal Society is to make the research material published in the journals widely available as cheaply and readily as possible to users. To this end, online publishing has been introduced to facilitate access to the journals by readers, and page charges have been introduced to transfer some of the publication cost from readers to funded authors. Our long-term vision is that the cost of publication would be borne indirectly by science funding agencies via their grants, which should incorporate the cost of research publication. Thus, two key objectives for New Zealand science would be met: 1) A readily available publishing avenue for New Zealand and regional papers, and 2) worldwide exposure of New Zealand authors and results.

Scope and scale of journal publishing

The seven journals receive more than 400 submissions per year, of which, on average, 80% are published in 28 quarterly issues. In 2002, the journals published a total of 299 scientific papers.

All papers are edited by professional scientific editors, and are peer reviewed by at least two referees, normally including at least one from overseas. The editing, reviewing, and typesetting processes account for approximately two-thirds of the cost of journal production; remaining costs are associated with print and distribution activities.

The journals publish papers in the following disciplines (as listed by the Institute of Scientific Information):

- Agriculture/Agronomy (*NZJAR, NZJCHS*);
- Aquatic Sciences (*NZJMFR*);
- Animal Sciences (*NZJZ*);
- Earth Sciences (*NZJGG*);
- Multidisciplinary (*JRSNZ*); and
- Plant Sciences (*NZJB*).

These disciplines accounted for 22% of all New Zealand-authored papers in the period 1997-2001, and within these fields the Society's journals published 25% of the New Zealand-authored papers.

2 Highlights

Procedural Highlights:

The Royal Society has greatly developed and enhanced its publishing activities over the last year. Our improvements included:

- *Online publishing for all journals:* After a trial year of publishing online in 2002, we have established free online access for print copy subscribers, and online-only subscriptions at a reduced rate. This has improved times to publication by several weeks for most papers, and more importantly, disseminates journal information to a much wider readership for little or no cost.
- *Increased electronic management of manuscripts* for all stages from submission, through to assessment, editing, proofing and publishing. This increases the efficiency of our processes, eliminates postage costs and will lead to shortened times to publication.
- *Provided authors with free PDF access* to their paper upon publication. This improves our service to authors.
- *Recently re-constituted Editorial Boards have established future strategies for their journals.*
- *New page charges and increased subscription prices*, but allowed bulk "institutional" subscriptions for 2003, with the introduction of online publishing. While journals continue to be produced in printed form, their additional costs of printing and worldwide distribution must continue to be met by realistic subscription prices. This is despite our moves towards free access via the online publication. The effects of this are discussed in Appendices XI, XII & XIII.
- *Increased operating efficiencies*. Production costs have been reduced by 20%, due to lower printing costs, increased usage of electronic processes, and a change in our US agent's fee structure.

Publication Highlights

Special issues of JRSNZ and NZGG

The March 2003 issue of the JRSNZ was a 500 page tribute to the late Professor John Campbell, which included 21 papers on biostratigraphy and paleontology. (Note that the *JRSNZ* might more descriptively be titled the *New Zealand Journal of Natural History* from its subject matter coverage.)

In June 2003 an issue of *New Zealand Journal of Geology and Geophysics,* entitled *Profiling mass extinction: the K/T event from swamp to deep ocean* sold an extra 250 copies. The papers were primarily the outcome of a Marsden Fund grant awarded to Dr Chris Hollis (GNS), and PGS&T funds also contributed. The Cretaceous/Tertiary (K/T) boundary is the place in time 65 million years ago, recorded in the stratigraphic record, when many forms of life (including the dinosaurs) suddenly became extinct. The special issue contained a group of papers analysing New Zealand's record of the K/T boundary, increasing each paper's impact and reach. The work has laid the foundation for further major research, both on New Zealand-focused and global themes. For example, the mass extinction findings provide an analogue for the effects on biodiversity of possible future catastrophic events such as nuclear war, asteroid impacts and climate change.

Published papers of special significance

Stevens, P.; Froud, K.; Jamieson, L. 2002: Effects of adult feeding on longevity and fecundity of *Ctenopseustis obliquana* (Lepidoptera: Tortricidae). *NZJCHS. 30*: 229-234.
The New Zealand Society for Horticultural Science awarded their *Best Paper* award to Philippa Stevens, Karyn Froud, and Lisa Jamieson (HortResearch) for their paper on a key horticultural pest: brownheaded leafroller.

Brownheaded leafroller is a serious pest, damaging a large range of horticultural crops, including kiwifruit. It can be controlled biologically by parasitoids present in the orchard environment. Parasitoids are encouraged by the presence of sources of nectar in orchards, but although some growers put flowering plants in their orchards, their impact on the actual leafroller population had never been assessed. Theoretically, planting flowers could be counter-productive, also feeding leafrollers and increasing their numbers!

The authors found that the provision of nectar through a range of flowering plants is unlikely to increase brownheaded leafroller populations, and thus should help to control them by encouraging parasitoids. However, growers should not include any plants that are hosts of leafrollers. This paper provides the first published information on the impact of different food plants on the adult stage of the leafroller, and adds significant fundamental knowledge on the biology of adult leafrollers, about which little is currently known.

This work was funded by the Foundation for Research, Science and Technology and is an example underpinning entomological research that also provides practical outcomes for growers.

"I chose the NZJCHS to publish this work as I wanted the results to be readily accessible to a New Zealand audience. The pest is an endemic species that has moved into the modified horticultural environment so the research was highly relevant to New Zealand audiences. At the same time I wanted to publish the work in a journal with a reputation for publishing high quality research. As the work covered ecological aspects of pest management, rather than more applied work (for example chemical spray trials), the journal seemed more suitable than other potential publications in New Zealand. The advantages of publishing in this journal included its accessibility and good profile within the New Zealand horticultural and scientific community; reputation for high quality publication; and quick publication time." [Philippa Stevens].

Davey, M. L.; O'Brien, L.; Ling, N.; Gleeson, D. M. 2003: Population genetic structure of the Canterbury mudfish (*Neochanna burrowsius*): biogeography and conservation implications. *NZJMFR. 37*: 13-21.
This paper, published by Marlene Davey from Landcare Research and co-authors from the Universities of Canterbury and Waikato is about the rare Canterbury mudfish which lives in lowland areas of Canterbury, where its habitats are threatened by changes in rural land-use. Although this hardy fish can survive deep in creek beds during droughts, it is nevertheless a poor competitor, and is restricted to marginal waterways. The authors examined DNA sequences of fish from eight sites and, in combination with ecological studies, were able to recommend practical ways of managing this threatened species in ways that will to maximise likelihood of its survival and maintain its genetic diversity.

The research was funded by the Foundation for Research Science and Technology's Biodiversity and Threatened Species Programme.

"Their scientific approach and findings will be of interest to many conservation biologists who are grappling with comparable management problems in many parts of the world." [Mike Winterbourn, NZMFR. Editorial Advisory Board member].

The senior author, Marlene Davey, wrote:

"We chose NZJMFR to publish our paper on Canterbury mudfish for two main reasons. First, we wished to publish the paper in a well recognised New Zealand journal to maximise exposure of our results to New Zealand scientists and conservation management people. Second, the NZJMFR has an efficient review process enabling our results to be published promptly."

3 Progress and Achievements Evaluation

Supporting New Zealand Research - Percentage of New Zealand-authored papers published by the Royal Society of New Zealand journals

Our national journals are categorised by the Institute of Scientific Information (USA) into the six different subject fields shown in Figure 15 that together comprise 22% of all New Zealand-authored publications. Within their respective fields, the New Zealand journals published by the Royal Society are significant publishers of New Zealand research, publishing 15–35% of the New Zealand-authored papers. Both NZJAR and NZJCHS are classified into the Agriculture/Agronomy field, and together they publish nearly 60% of New Zealand's papers in this field. Overall, in the period 1997-2001, the Society's journals published 6% of New Zealand-authored papers across all disciplines.

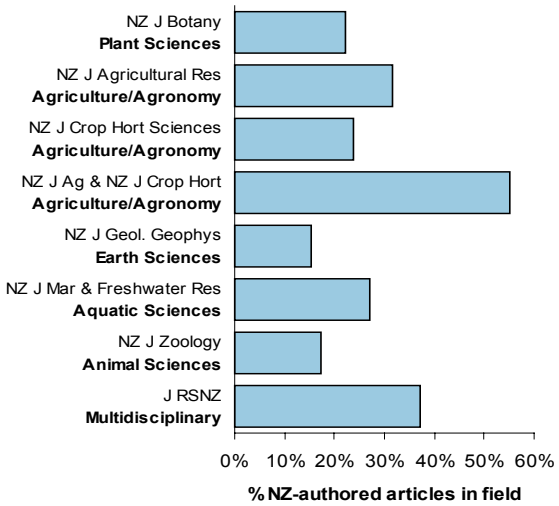


Figure 15. The percentage of New Zealand-authored papers published in the RSNZ journals, by subject field. Source NZ National Citation Report, 1997-2001, Institute for Scientific Information.

Impact of the Journals: impact factors and rankings

Journal impact factors calculate citations per article in the two years following publication. They are a commonly-used measure of the short-term scientific impact of a journal. Over the previous decade, five of the seven journals have recorded upwards trends in their impact factors (Figure 16).

The Society's journals have maintained strong rankings in relation to many other international journals in their fields. This is a noteworthy achievement. In six subject categories, our journals are ranked within the top 50% of similar journals. Outstanding in this regard is JRSNZ (ranked 12th out of 48 similar multidisciplinary science journals) and NZJAR (ranked 10th out of 28 Agriculture journals); other good performers are NZJGG (14th of 34 Geology and 59th of 122 Geoscience journals), NZJB (66th of 135 Plant Science journals), and NZJZ (55th of 109 Zoology journals).

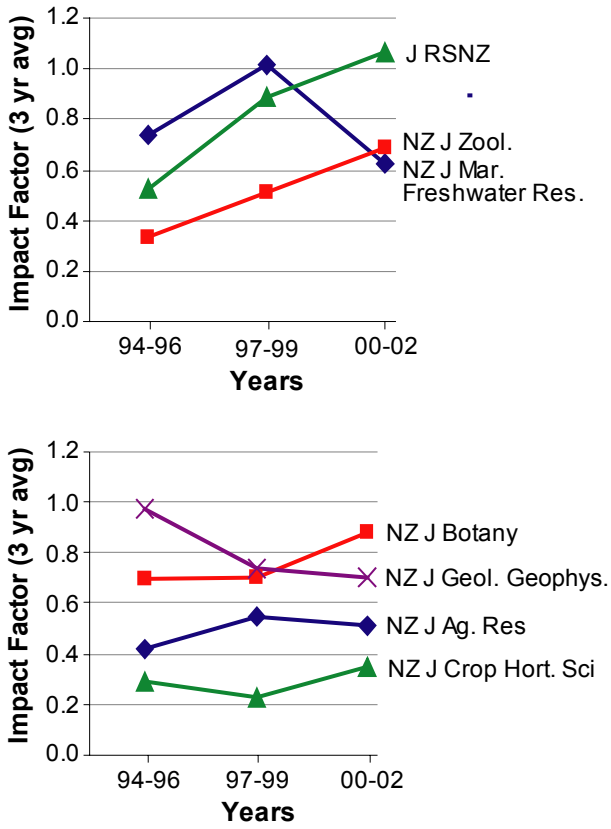


Figure 16. Impact factor trends of the RSNZ journals: JRSNZ, NZJZ, and NZJMFR (top graph), and NZJB, NZJGG, NZJAR, and NZJCHS (lower graph). Because impact factors fluctuate year to year, impact factors have been averaged over three year periods.

Increasing Global Connectedness: International papers, readership, and refereeing

While the journals are largely regional in scope, they are nevertheless of interest internationally, as shown by the percentage of overseas subscriptions (52%) and published papers (23%) (Figure 17). The quality of publications is maintained to an international standard by the refereeing process, which in 2002 used 65% referees from overseas.

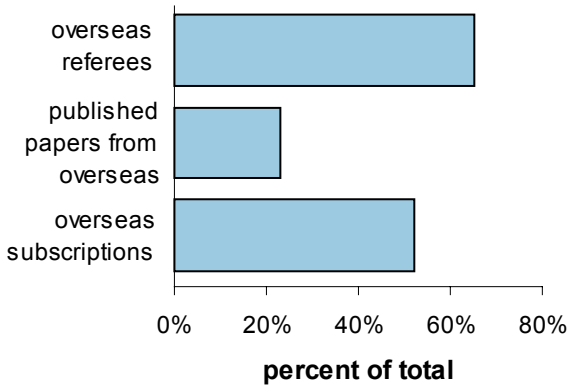


Figure 17. The percentage of overseas referees, subscriptions and published papers in the Royal Society journals for 2002.

In 2002, published papers from outside of New Zealand were from the following 26 countries:

> *Argentina, Australia, Belgium, Brazil, Canada, Chile, Denmark, Fiji, Germany, Greece, Hawaii, Hong Kong, Ireland, Italy, Japan, Jordan, Korea, Netherlands, New Caledonia, Norway, Russia, Spain, Turkey, United Arab Emirates, UK, USA.*

Submission trends

With effect from 2003, all papers submitted to the journals published by the Royal Society became liable for a $50 page charge (to a maximum of $500 per paper) upon publication. The page charges may, however, be waived for authors who lack funding or other personal hardship. Appendix XI provides an analysis of the effects of page charges on submissions. Our main findings are:

- For all but one journal, submissions increased markedly in 2002 prior to the imposition of page charges, presumably because authors submitted their papers early to avoid charges.
- Subsequent to the imposition of page charges, three of the 7 journals: NZJAR, NZJCHS, and NZJGG maintained their normal rate of submissions and therefore do not appear to have been adversely affected by page charges.
- Submissions to NZJB and NZJMFR decreased since page charges were introduced. However, both journals already had exceptionally high submission rates in 2002.
- The decrease in submissions to NZJB appears to be related to the inability of most authors to pay page charges, perhaps being unaware of waiver possibilities. The reason for the decline in submissions to NZJMFR is unclear at present, however it appears to have been temporary, because in the latter half of 2003 (outside of the period covered by this report), submissions to NZJMFR increased again.
- Both NZJB and NZJMFR have sufficient material in the system to enable publication to continue without adverse effect.
- Low levels of submissions to the two smallest journals, NZJZ and JRSNZ have been exacerbated by page charges.

- Despite the adverse effects of page charges on some journals to date, these should be lessened over the longer term if sufficient funding is built into the research before publication.

Subscription Trends

An analysis of journal subscription trends over the last eight years is presented in Appendix XII. A worldwide squeeze on library funds has led to decreasing sales of regional journals over the last decade. The New Zealand journals published by the Royal Society have been affected by this trend, and an additional three factors affected subscription rates for 2003:

- Online publishing, which has improved access by individuals, especially within Institutions, to institutionally-subscribed journals;
- A 2003 increase in the subscription price (which had not increased for several years); and
- Prior to 2003, page charges were waived for authors who also subscribed to the journal. This waiver was dropped in 2003, reducing subscription incentives.

We observe the following:

- The New Zealand market is predominantly individuals who now have "free" access to online journals through their institutions and therefore no longer need a personal subscription. By contrast, most overseas subscriptions come already from institutions.
- Despite a subscription decrease, the price increase is sufficient to maintain subscription revenue, which is anticipated to increase by 18% in 2003.
- Subscriptions to all journals decreased in the 2003 year by an average of 17%, with the sharpest decline coming from subscriptions from New Zealand (32% decrease, see point 1 above).
- From 2003, online subscriptions became available at lower cost than the print & online option. Initially, only 15% of subscribers within New Zealand have opted for the online-only subscription.
- The decrease in New Zealand subscriptions has not been reflected overseas. The US market has remained fairly steady, and the Asia/Australia market has increased by 11%, while there have been some decreases in Europe; and
- The New Zealand journals published by the Royal Society are being sold and distributed internationally through the marketing and fulfilment services of two subscription agencies: Allen Press in the US and Eurospan in the UK.

The decline in subscriptions was expected. It illustrates the effect of the Society's recent moves in online publishing, which make the journals available to a wider readership at little cost to the individual reader.

Electronic publishing

Use of journal website

The growing importance and desirability of electronic journal publishing can be illustrated by comparing the number of hits on the Publishing website between 2002 and the first seven months of 2003, and in particular, the number of "requests" for journal articles in PDF form. For just the first seven months of 2003 there were 1,235,778 hits on the website (versus 918,462 for all of 2002) and 145,985 requests for PDFs (versus 65,637). This indicates an average increase in our publishing website usage of 230% in 2003, and an average increase in PDF requests of 381%. Such increases are more remarkable when we consider that the articles published in 2002 were (and still are) free to view; while those published in 2003 are available only on subscription. For more detail see Appendix XIII.

Opinion survey findings: Survey of Geoscientists

The Society has carried out several surveys in previous years to assess the attitudes and needs of journal users. The responses have helped to formulate our future policies with respect to online publishing, improvements in production, and other improvements to ensure that the journals remain relevant and provide the best service to their users. Our February 2003 survey of users of NZJGG produced the following results:

- the quality and international standing rate well for what is largely a regional journal;
- reviewing standards are high and rigorous, but the review process and editing are slow;
- most people are happy to use electronic processes for review and proofing;
- print journals are the single preferred medium, but additional online access is equally important; and
- half the respondents intend to submit papers within the next year because the scope of the journal is relevant. Of the third who will not submit, one-quarter cite page charges as the reason, but most consider the relevance of scope to be more important.

The most commonly suggested improvement, from nearly a third of respondents, was to reduce the time to publication. The second suggested improvement was more special issues and review papers.

70% of respondents indicated that the biggest issues facing the journal were funding and page charges.

The survey supported our strategies for developing electronic handling processes and online publication, but not at the expense of the printed journal.

4 Policy Implications and Future Investment Priorities

In line with a growing trend in world science publishing, the Royal Society advocates the free availability of published scientific information to as wide an audience as possible. This is being made increasingly possible with the introduction of electronic publication of the journals online. The Royal Society commends to government a view of publishing which sees publication as the final and essential step in the research process. Under the most developed version of this vision, processes for reviewing and editing of articles would be paid for by page charges. Articles would then be published free to the web for all to read. Two key objectives for New Zealand science would be met: 1) A readily available publishing avenue for New Zealand and regional papers, and 2) worldwide exposure of New Zealand authors and results.

By 2010 we would like to see a situation where:

- The Society publishes 10, not 7 journals, with titles being added to cover Social Sciences; Environmental Science, Ecology and Biosecurity; and Food Systems and Biotechnology. Each journal will be aggressively marketed to reach beyond New Zealand to include those parts of the southern hemisphere (eg. Pasifika, South America, South Africa) where similar ecological or social questions exist (for instance in areas of biosecurity or indigenous populations).
- Journals are refereed and published electronically, and are available free via the web to readers worldwide. This follows a “public good” line of thought, where (government) funds are invested in 1) ensuring international exposure for New Zealand science, and 2) a waiver of page charges for authors not in receipt of funding.
- Papers are published electronically on an "as ready" basis, for later assignment to a designated issue or issues. Annual bound versions are printed if demanded for purchase and for archive purposes.
- Publication is seen a legitimate and integral step in completion of the research. Thus, New Zealand-funded and overseas authors would pay a publication charge. This would be waived for non-funded New Zealanders.

- For New Zealand institutions, costs are mostly shifted from reader subscription to author (i.e., institution) pay. For some institutions, overall costs might go down due to decreased subscription charges, while for others they may increase, due to increased page charges.
- Where appropriate, academic editors would be sought as a prestige position, and would receive an honorarium.

In the Society's view, the scenario above would:

- give the journals a solid focus as "Southern Hemisphere" regional journals;
- give New Zealand authors access to world-wide readership;
- be in line with current international moves to "open access" as technology allows; and
- be financially viable with continuing 'public good' input from government.

This proposal is in line with current developments in the publishing industry. Around the world, frustration is mounting with the rising subscription costs and high profit margins of the world's most prestigious journals, some of which cost more than $11,000 a year. The alternative, now being pursued by several agencies, is to make published information freely available, thus heightening a journal's impact. The Public Library of Science (www.plos.org) argues that research paid for with government funding should available free to everyone, since taxpayers have already paid for it. They have recently established an online journal, the contents of which are available to anyone who logs onto the Internet. In its first issue, the peer-reviewed publication featured a study on brain implants that prompted 80,000 downloads immediately after publication.

New Zealand's funding agencies already regard the cost of publication as a legitimate part of full-cost funding. Thus, at least part of the publication cost of articles sourced from such projects is already covered. However, individual researchers, newcomers or those recently retired may not have access to project funds, and the Society recommends that they be subsidised by government funds for publication. Thus, the subsidy coming to the Royal Society from government would, based on the most efficient and timely publishing methods available, assist New Zealand authors unable to pay the cost of publication, and give worldwide exposure for New Zealand papers.

Author page charges are expected eventually to progress to the point where all publishing costs will be covered by the appropriate research organisations and funders. However, until such time as this occurs, there will remain a proportion of cost, particularly of the printed journals, which must be recovered by subscription charges to the users.

MoRST has recently commissioned a review of the New Zealand journals published by the Royal Society (Rowland, 2003), and the Royal Society agrees largely with the report's main points. In light of this review and our strategic direction for the journals (above), we recommend that in the short and medium term:

- the Society continues to publish all 7 journals (subject to funding availability);
- the Society appoints an academic editor for JRSNZ*;*
- funding be provided to relieve the current deficit, and further, funding be restored to pre-inflationary levels;
- the Society continues to implement cheaper and more effective distribution options;
- the Society continues to improve electronic review and production processes;
- the Society works towards its stated long-term goals for publishing, and that the means be made to enable us to do this; and
- the government support free access to the journals as a "public good".

ALPHA AND GAMMA SERIES

1 Overview

Alpha series

The **Alpha** resource tells the story of current New Zealand science and technology. While it is primarily designed to support the learning of science and technology in the school curriculum, it is also appropriate for the general public. To increase their usefulness in schools, links are made to specific objectives in NZ Curriculum statements, and they also often provide career information. They are produced at four levels of the school curriculum ranging from junior primary to senior secondary. The writing and production involves collaboration between science and technology and education; topics and manuscripts are chosen in consultation with scientists, technologists and educationalists.

A number of issues have been made available through retail outlets such as the Science Centres, through libraries and some sponsor organisations have used the Alpha as part of their own public relations activities.

Gamma series

The **Gamma** resource gives a balanced and factual account of the science behind scientific issues in the news. While it is primarily designed to support the learning of science and technology in the school curriculum, it too is appropriate for the general public. Many public libraries subscribe to the series, and particular issues have been made available to journalists and other groups in the community. The Gamma series is now freely available on the Royal Society website http://www.rsnz.org/education/gamma/

2 Progress and Achievements Evaluation

Four issues of Alpha and five of Gamma were produced in 2002-03:

Alpha series

Alpha 113 - “Climate variability and climate change” was written by Lesley Mackintosh (New Zealand Science, Mathematics and Technology Teacher Fellow 2001), while being hosted by the National Institute of Water and Atmospheric Research (NIWA). Co-sponsored by both NIWA and the Otago Regional Council, the Alpha explores and presents fully the growOTAGO project which has produced climate and soil maps of Otago with specific reference to 13 regions in the province. How the climate maps are produced is detailed, as are the ways of gathering information about the climate. Of particular interest is the creation of ‘last frost’ maps.

Alpha 114 - “Sedimentation - its impact on estuaries” was written by a team at NIWA led by Alf Norka and Sara Hatton. Estuaries are introduced as areas of rich and diverse biological systems which New Zealand has throughout the country. The causes of sedimentation are explained and the impact on its ecosytem is detailed. Case studies are presented from both the Whangapoua estuary and the Okura estuary. Research methods used by NIWA are described and the need to conserve estuarine areas as an important part of our environment is emphasised.

Alpha 115 - “Alan Cooper - explorer and scientist studies bones” (in press) Co-written by Linda Chronis and Louise Thomas. The career, to date, of Alan Cooper from babyhood, student, caver, frisbee enthusiast and now director of research at the Henry Wellcome Ancient Biomolecules Centre at Oxford University is presented as a fascinating narrative of Alan’s scientific work including the first complete extraction of DNA of a mitrochondral genome from an extinct species: the moa. The links with his colleagues, including his father Roger, and mentors illustrate the importance of sharing and exchanging information and views. An adventure story with a strong scientific context.

Alpha 116 - "Fatal Impact - the asteroid that wiped out the dinosaurs" was written by Dr Christopher J Hollis, Institute of Geological and Nuclear Sciences (GNS) and sponsored by the GNS Global Change Through Time programme (Foundation for Research, Science and Technology PGS&T contract).

Accompanied by teacher notes and student activities, this Alpha examines the evidence for the event throughout the world with particular reference to research done in New Zealand in collaboration with

overseas scientists. The New Zealand KT boundary sites are detailed and there is a section on the up side of such events with evidence cited about evolution in its broadest sense following the meteorite impact.

Alpha 117 - "New Zealand streams and rivers" was written by Scott Larned of the National Institute of Water and Atmospheric Research, Christchurch and is also accompanied by teacher notes and student activities. The Alpha examines the complexity of river and stream ecosystems, the impact of the four major land use changes and the state of the world's waterways. The New Zealand river scenario is detailed and there is a section on success stories: cases where there has been successful restoration of rivers and streams. This Alpha was sponsored by NIWA, Christchurch.

Gamma series

- Eating disorders
- 1080 - Who's taking the bait
- Meningococcal disease - it's a killer
- Smallpox - an eradicated virus or a biological weapon?
- SARS - the early days

3 Policy Implications and Future Investment Priorities

Both series provide a valuable public information service and have at times been requested by public libraries or provided to politicians, government agencies or other organisations. Plans for the 2004 Alpha series include issues on biotechnology and electronics, as areas identified as having strategic importance for New Zealand.

Staff costs for both series have been provided through the Output Agreement with MoRST while production costs of the Alpha series have been provided by sales and sponsorship. Sales figures have increased slowly but steadily over the past four years, as has the interest and sponsorship from external organsations. The series cannot be totally self-funding as the NZ market is not large enough, and sponsorship is erratic.

INTERNATIONAL

INTERNATIONAL SCIENCE AND TECHNOLOGY (ISAT) LINKAGES FUND

1 Overview

The ISAT Linkages Fund was established in 1994 with two broad goals:

- to support government's multilateral and bilateral international commitments; and
- to enhance researcher and institutional linkages to ensure that New Zealand's science and technology activities are fully integrated with the best international research and development efforts.

The strategic component of the Fund is administered by the Ministry of Research, Science and Technology and four contestable programmes of the Fund are administered by the Society.

In 2002-03 the Fund aimed at younger researchers, or where there were new linkages or activities. The programmes included the:

- Bilateral Research Activities Programme (BRAP);
- NZ/USA Science and Technological Co-operative Science Programme (NZ/USA CSP);
- NZ/FRG Scientific and Technological Co-operation (STC) Agreement Programme (FRG); and
- NZ/Deutsche Forschungsgemeinschaft Programme (DFG).

2 Highlights

In 2002-03, 104 applications seeking funding were received with 73 contracts (70%) being awarded. The total value of the contracts amounted to $281.5k. 17 different countries were involved.

The following are two examples of ISAT projects undertaken in 2002-03:

Islands as model systems for studying the role of nest predation in life history evolution

Dr James Briskie of the University of Canterbury received an ISAT grant to fund a visit to New Zealand by Professor Thomas Martin, Assistant Director of the Montana Cooperative Wildlife Unit. The collaboration assisted greatly in the development of a study of the effects of predation on the evolution of bird behaviour. This study is a world first, comparing New Zealand native birds' behaviour (evolved under low-predation conditions) with the behaviour of their closest relatives overseas (evolved under conditions of very high predation). As well as increasing our fundamental understanding of how nest predation influences the evolution of bird behaviour, the results of this study will identify traits that place New Zealand birds at particularly high risk of predation, and this will be useful in identifying the most vulnerable species, and the life-cycle stage at which they are most at risk. This information can be used in planning long-term efforts to reduce nest predation of New Zealand native species.

Professor Martin is a leading international expert on life history evolution, and brought to the project 25 years of experience in the field. During his visit, he not only helped Dr Briskie with developing the project, but also provided training to students on the project, and held a seminar and discussion group. He subsequently presented a joint poster on the preliminary results of the project at the 2002 meeting of the International Society for Behavioural Ecology in Canada.

The collaboration is continuing, with joint applications for future funding now being submitted to both the National Geographic Society, and the National Science Foundation, USA. Professor Martin told Dr Briskie that he saw a large potential for future work in New Zealand, and has invited Dr Briskie to visit his institution. In addition to their substantial progress on the current project, the two discussed several new initiatives for the future.

Characterisation of oxygen-sensing pathways in prokaryotes

Dr Julian Eaton-Rye, University of Otago was funded by ISAT to spend one month in France, hosted by Dr Ursula Liebl, Laboratory of Optics and Biosciences, CNRS. The collaborative project aimed to determine how nitrogen-fixing bacteria sense and respond to low oxygen levels. Nitrogen-fixing bacteria convert nitrogen from the atmosphere into ammonia: a nitrogen-containing compound that is used by plants and is necessary for their healthy growth. While it is known that a key enzyme in bacterial nitrogen fixation is inactivated by low oxygen levels, the mechanism by which these bacteria sense and then respond to low oxygen is not yet known. As well as increasing our understanding of the biologically, agriculturally and environmentally important process of nitrogen-fixation, the results of this project will be particularly relevant to New Zealand because the bacteria studied, *Nostoc punctiforme*, plays a key role in supplying nitrogen to New Zealand ecosystems through its symbioses with various lichens. In addition, understanding how bacteria sense oxygen may reveal therapeutic targets for treating bacterial infections, and it is anticipated to lead to the design of biological oxygen sensors for biotechnological applications.

Dr Liebl and her laboratory co-workers have pioneered the use of state of the art instrumentation for measuring the activity of biological oxygen sensors. This instrumentation is not available in New Zealand. During his visit, Dr Eaton-Rye obtained experience with the equipment and with the sample preparation techniques required, laying the groundwork for a collaboration in which his New Zealand team will prepare bacterial samples and send them to Dr Liebl's laboratory for analysis of their oxygen sensor activity. Dr Eaton-Rye and Dr Liebl are now seeking mainstream funding for this work.

Evaluation Highlights

Many recipients reported that the collaboration was especially valuable in assisting with the development of long-term ongoing links with other researchers while others commented that the transfer of knowledge and expertise from overseas institutions to New Zealand laboratories was extremely good "value for money" considering the Fund's size.

In their final reports, 99% of recipients stated that further collaboration was anticipated, and 62% anticipated a future mainstream funding bid, most often to an overseas agency.

3 Progress and Achievements Evaluation

Applications and Success Rates

Applications for funding are called for once or twice yearly with panels of five or six eminent scientists evaluating the applications and providing recommendations for funding.

Table 7. The total number of applications received (by programme) and the total number and value of the applications supported for 2002-03.

ISAT Programme	Number of Applications Received	Number of Contracts Awarded	Amount of Contracts (GST incl)
Bilateral Research Activities Programme	55	41	$172,985
NZ/USA Cooperative Science Programme	28	17	$58,600
NZ/FRG Scientific and Technological Cooperation Agreement Programme	21	15	$49,920
TOTAL	104	73	$281,505

There was no funding allocated in 2002/03 for the NZ/Deutsche Forschungsgemeinschaft Programme (DFG).

Collaborating Countries

Figures 18 and 19 show the numbers and the values of ISAT contracts issued for the 5 years to 30 June 2003 ("World" covers all countries other than Germany and the USA). Since 1998 there has been an increase in the value and number of contracts for collaborations with countries other than Germany and the USA and a corresponding decrease in the value and number of collaborations with Germany and the USA.

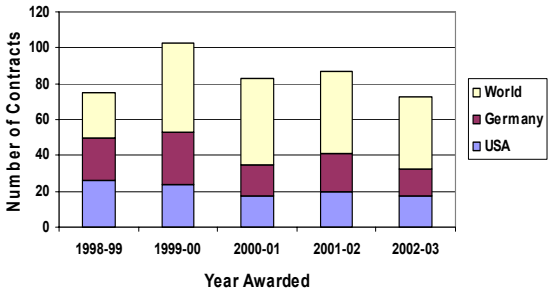


Figure 18. Number of ISAT contracts awarded by country and year

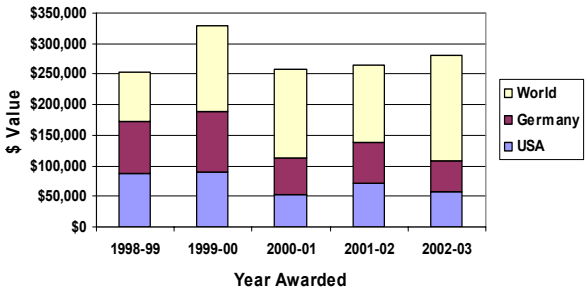


Figure 19. Value of ISAT contracts awarded by country and year

The diversity of collaborating countries is shown by the fact that since the Royal Society has been administering the ISAT Fund, collaborations have been funded with 39 different countries (full details in Appendix VI).

Outcomes from 2002-03 ISAT grants

Activity reports are required to be furnished at the completion of each ISAT visit and results of our evaluation of these reports are shown in Table 9.

Table 8. Activity reports for ISAT grants

Indicator	% completed 2003 grants
New Zealand researcher visited overseas Institution	68%
Overseas researcher hosted in New Zealand	32%
Workshop was held	65%
Collaboration was felt to have contributed to the recognition of New Zealand as a centre of innovation	40%
Intention to publish work arising from the collaboration	92%
Future collaboration is anticipated	97%
Collaboration is anticipated to assist with a mainstream funding bid	62%
to overseas agency	35%

to FRST	12%
to HRC	0%
to Marsden	5%
to other/unknown New Zealand agency	12%

Ongoing Collaborations

Many of the recipients advised that they are now much better placed to seek mainstream funding for ongoing research. From the completed 2003 grants, 97% of investigators anticipated future collaboration and 62% felt that the collaboration would assist with a future mainstream funding bid. The majority of these bids are anticipated to be to overseas sources (Figure 20).

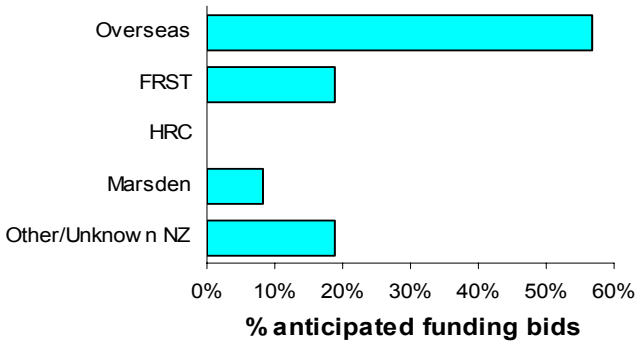


Figure 20. The percentage of anticipated bids that are expected to be made to different funding sources.

Benefits to New Zealand

The stated benefits to New Zealand of ISAT-funded collaborations fall into four main categories:

- improved research capability through:
  - New Zealand researchers developing new skills, knowledge and ideas; and
  - access to equipment and reagents not available in New Zealand;
- participation of New Zealand researchers in world class research;
- enhancement of the reputation of New Zealand research and innovation; and
- research applications and new technology development in areas such as industry, environmental management, health, agriculture, fisheries and forestry.

Recognition of New Zealand as a centre of innovation

Twenty-four grant recipients stated that their collaboration had contributed to the international recognition of New Zealand as a centre of innovation and a further 3 recipients stated that New Zealand was already well known as a leader in the field before receiving the grant. Grants that were said to have contributed to the recognition of New Zealand as a centre of innovation were more likely to have hosted an overseas visitor in New Zealand than to have funded a New Zealander's visit overseas, and they were more likely than not to have held a workshop or seminar. This trend will be monitored in future years to see if it continues.

4 Policy Implications and Future Investment Priorities

The majority of the universities and crown research institutes and other institutions find that the linkages are extremely valuable to both the organisation and to the individual researchers themselves.

The Fund assists many mid-career and young New Zealand researchers to gain access to knowledge and innovative technologies developed in international research institutions and universities.

International links are important, not only to researchers and the research institutions, but to New Zealand. The collaborative links funded through ISAT continue to maintain, improve and enhance New Zealand's international reputation through its participation in joint collaborative projects as well as exposure through involvement in international conferences etc.

Therefore, the Society is pleased to acknowledge that the ISAT Linkages Fund has received a substantial increase in funding for 2003-04. This has already been welcomed by the science community. In addition, with a slight relaxation in the eligibility, mid-career researchers can now seek funding. An added highlight is that funding can now be allocated for up to two out-years.

These changes will contribute to enhanced global connectedness by providing the means for New Zealand researchers to fully participate in the processes that precede the establishment of a joint research programme. This is an area where researchers in most developed economies are able to access substantial grant funding through research funding agencies. In contrast, assistance available to New Zealand researchers is very restricted; an issue frequently cited as a significant impediment to developing closer international research relationships.

In relative terms New Zealand's research effort is extremely modest. Facilitating the linkage between NZ research and researchers with their foreign counterparts will bring immediate benefits in terms of greater access to foreign research expertise, technologies and research infrastructure, and the learning and capital efficiencies that flow from that exchange

Following their review of the ISAT Linkages Fund in 2002, MoRST allocated an additional $265.0k to the ISAT funds administered by the Society, and the scheme was changed to permit grants to be made for up to 3 years. The Society has welcomed these changes. The extension of grants to up to 3 years will necessitate temporarily setting-aside a proportion of the next two years' funding in order to maintain granting levels in a smooth trend.

OTHER INTERNATIONAL ACTIVITIES

1 Overview

On behalf of the Government, the Royal Society is a member of, and maintains close links with, the International Council for Science (ICSU), 20 international unions and 11 scientific associates and committees – a full list is attached as Appendix VII. The activity also provides support to New Zealand delegates attending international general assemblies/congresses and meetings etc and limited seed funding to allow international conferences/fora etc to be held in New Zealand.

Tangible benefits accrue to New Zealand from its international links in research, science and technology. The links allow New Zealand to contribute to, and draw from, the global effort. To this end New Zealand must continue to develop and maintain excellent, focused and active links with international science. Global economic, technological, social and environmental change will continue to affect the way New Zealand interacts with the rest of the world and its continuing role in research, science and technology.

2 Highlights

At the present time, seven eminent New Zealand researchers hold positions on international union committees or commissions. In particular, Professor David Parry, Massey University is the Vice-President of the Board of the International Council for Science (ICSU), a very senior and prestigious position, while Dr Clive Howard-Williams FRSNZ, NIWA is the Vice-President of the Scientific Committee on Antarctic Research (SCAR), and Dr Julie Hall is the Secretary of the Scientific Committee on Oceanic Research (SCOR).

Also a highlight was the visit to New Zealand by Dr Neil Hall, Wellcome Trust, United Kingdom and Dr Owen White, Maryland Institute of Genomics, USA, as part of the celebrations for the 50th Anniversary of the discovery of the structure of DNA.

3 Progress and Achievements Evaluation

International Memberships

The international links are unanimously viewed as being important because they enable New Zealand researchers and research organisations to:

- gain access to and share: information, resources, data banks, colleagues, equipment, programmes, technologies, funds, and techniques. This access to resources develops New Zealand's RS&T capacity, expertise, confidence and knowledge base;
- operate more effectively in a global research market, maintaining competitiveness and international relevance; and
- maintain and improve institutional international reputations through participation in global bench marking/quality control programmes and international conferences.

Subscriptions to the memberships of international unions and other organisations remain a concern as they continue to increase each year and are also affected by the fluctuation of the New Zealand dollar. In 2003 the subscriptions totalled $92.6k.

International Travel Assistance

Financial assistance totalling $36.1k has been provided to 14 New Zealand delegates to attend their respective international general assemblies or congresses etc. These are listed in Appendix VIII.

Reports are received from the delegates and assessed and any recommendations are considered and acted upon as appropriate. Copies of the reports are forwarded to the appropriate scientific societies and the delegates are asked to provide an article for appropriate scientific society newsletters. The Society's electronic newsletter "Alert" also features abstracts from these reports.

International Funding Assistance for Symposia/Workshops

Seed funding to seven symposia/workshops held in New Zealand has amounted to $24.8k. These are listed in Appendix IX.

International Visitors to the Society

The Society continues to liaise with overseas visitors using its own, as well as government resources.

4 Policy Implications and Future Investment Priorities

As a major funder of research the Government has a substantial responsibility for international collaboration. Furthermore, international collaboration and participation is necessary to discharge global responsibilities (e.g. biosecurity, climate etc).

There are costs associated with international collaboration over and above the costs of research. Effective collaboration needs travel and time to be expended on exploring opportunities etc and with New Zealand physically being in a remote position in contrast to Europe and USA, funding is always problematic.

The Society is pleased to note that through the International Science and Technology Linkages Fund, funding for other 2003-04 international activities has been significantly increased. This increase will allow an increase in grants being awarded to major international conferences being held in New Zealand. International conferences in New Zealand assist in promoting New Zealand as a centre for innovation; they assist New Zealand researchers to develop relationships with reputable international researchers; and they help New Zealand to use overseas advances in RS&T for economic, social and/or environmental progress. It is recommended that the funding for major international conferences held in New Zealand be increased to $150 k in 2004-05.

Joint International Symposia

It is the Society's intention to introduce joint symposia with government's strategically important countries (e.g. NZ/France). This would involve estimated costs of $30 k per annum and it is recommended that discussions between the Society and the Ministry be held to discuss the advancement of this project.

OPERATING PRINCIPLES

The Society has a base of eleven key principles for its operations.

Focusing on results that benefit New Zealand

All funds administered by the Society focus on results that benefit New Zealand.

The *Marsden Fund* this year supported 105 projects over three years to undertake excellent research that enlarges the boundaries of knowledge and develops researchers with knowledge, skills, and ideas. The Marsden Fund *Highlights* and the *Progress and Achievements Evaluation*, earlier in this report, show that this is being achieved.

The *James Cook Research Fellowships* allow the researchers (usually 6 per year) to concentrate on their chosen research for two years. These two years of dedicated research enable them to focus a lifetime of study and scholarship on issues that advance New Zealand's role in knowledge creation. In particular the fellowships support excellent research and develop researchers with knowledge, skills and ideas. All past Fellows are continuing to carry out research derived from the work funded by the James Cook Research Fellowships and most have stressed that the impact of the Fellowship has been particularly important. Assessment of the reports given by Fellows shows that their research is internationally leading and has clear benefits for New Zealand.

Enthusiastic, passionate and inspirational teachers are critical to successful learning by children. *The Science, Mathematics and Technology Teacher Fellowship* scheme this year gave 58 teachers the opportunity to rekindle their interests and passions, and to bring these back to colleagues and pupils. The potential future benefits for New Zealand are immense.

Many of the 73 *International Science and Technology (ISAT) Linkages Fund* recipients this year advise that they are much better placed to seek mainstream funding for ongoing research after the initial collaboration has been completed and in many cases, there are significant long-term benefits to New Zealand resulting from continued and ongoing collaboration with internationally recognised experts. The use of “state-of-the-art” equipment, which is unavailable in New Zealand, is also considered to be a valuable component of the collaborations.

There are tangible benefits to New Zealand from its international links in research, science and technology. The links allow New Zealand to contribute to, and draw from, the global effort. To this end New Zealand must continue to develop and maintain excellent, focused and active links with international science. Global economic, technological, social and environmental change will continue to affect the way New Zealand interacts with the rest of the world and its continuing role in research, science and technology.

The New Zealand *Science and Technology Medals* were awarded this year to eight outstanding scientists who have made exceptional contributions, outside their normal work activity, to New Zealand society and culture through activities in the broad fields of science, mathematics, social science, and technology. In addition to the New Zealand medals, the Society regularly awards its own medals in specific fields. The establishment of a culture of pride in scientific and technological achievements is of great benefit to New Zealand and our national identity.

The affirmation provided this year via eight major projects to our young achievers through the $420k *Promotion of Science and Technology* activities encourages them to strive for greater achievement and to ultimately contribute to New Zealand and its future. The opportunity for them to mix with others of like mind but different culture will continue to broaden their outlook.

The journals published by the Royal Society are New Zealand's national research journals. They exist for the purposes of validating, recording, and disseminating the results of New Zealand research, or of research of relevance to New Zealand, particularly in the areas of natural science and primary production.

Collaborating with other agencies

The Society has ongoing relationships with MoRST, FRST, HRC, NZ Trade and Enterprise, Ministry of Education, Ministry for Economic Development, Ministry for the Environment, NZ Vice-Chancellors

Committee, Ministry of Foreign Affairs and Trade, Ministry of Agriculture and Forestry, Association of CRIs, CRIs, Research Associations, Universities and other tertiary institutions, the British Council, Fulbright Foundation, a number of private companies, and several Embassies and High Commissions.

The Society maintains a close relationship with the other two main purchase agents for Vote RS&T, FRST and HRC. We exchange information by, for example, participating in purchase agents meetings and also hosting or attending meetings held by these agencies with their providers and other interested parties.

The *Marsden Fund* provides FRST and HRC with a list of people involved in the successful proposals from the funding round, to ensure that the researchers are not being funded by different funding agencies for the same work. The evaluation teams of FRST, HRC, MoRST and the Society have monthly evaluation meetings at which the agencies update each another on their evaluation work. All four agencies have been cooperating on a bibliometric analysis of New Zealand research, and we maintain strong links on questions of human resource development.

Through the *James Cook Research Fellowship* scheme the Society has developed and strengthened links with CRIs, universities and other research associations, particularly at the individual level.

The *NZ Science, Mathematics and Technology Teacher Fellowship* programme develops and strengthens links between organisations especially local government, CRIs and universities at the individual and operational levels. External organisations involved are the professional teacher organisations (in sciences, mathematics, social sciences and technology), research institutions, universities, polytechnics, and enterprises such as industries, local government, art galleries, zoos and science centres in terms of promotion of the programme and selection and hosting of Teacher Fellows. Funding of the scheme is now contributed to by Ministry for Research Science and Technology and the Ministry for Economic Development. As a number of Teacher Fellows are engaged in work in the environmental science and environmental education areas, it may be considered appropriate for Ministry for the Environment to also contribute in the future.

The Masterclass series of seminars has also established new partnerships and relationships between institutions and help keep New Zealand scientists up-to-date with new areas of knowledge.

All relevant research agencies within New Zealand can benefit from publishing the results of their research in the New Zealand journals. The journals publish papers submitted from CRIs, universities and other research organisations whose research activities include current governmental policies in their portfolios.

Meeting current and future capability needs

In a *Marsden Fund* survey conducted in 2001, 59% of principal investigators replied that Marsden Fund funding had increased, or was anticipated to increase, their groups' capabilities in the long term. The Marsden Fund supports current and future capability needs by supporting the education of postgraduate students, providing opportunities for postdoctoral fellowships on leading research projects, helping the career development of emerging researchers, contributing to the retention of excellent researchers, and supporting the development of cutting edge skills and techniques. A selection criterion for the Fund is "contribution to development or broadening of research skills in New Zealand, particularly those of emerging researchers". On Marsden Fund projects selected in 2002, funding in the first year has provision for 44 FTE postgraduate positions and 28 FTE postdoctoral positions. The Fund has a Fast-Start programme for outstanding researchers at the beginning of their careers, with 18 recipients selected in 2002. In the 2001 survey, 8% volunteered the response that the funding is a significant factor in researchers being retained in, or attracted to, New Zealand. And the strong international collaboration supported by Marsden introduces many new skills and techniques into New Zealand, over and above those developed domestically.

The *James Cook Research Fellowships* have a role within the innovation system. They generate new knowledge and expand New Zealand's knowledge base and technological capabilities. The Fellowships contribute to achieving the target outcome of "People with knowledge, skills and ideas". The James Cook Research Fellows actively pursue knowledge and develop ideas and skills. They expand the knowledge base in specific areas to underpin future innovation across broad diverse areas of society. The Fellows also develop links with the global knowledge base. By way of being

prestigious, and by way of funding high quality research and overseas travel, the James Cook Research Fellowships have positive effects on recipients' reputations and in some cases also on their career progression. In most cases James Cook Research Fellowships have effects not just on Fellows but also on their colleagues, staff and students. These effects result from the Fellow being able to employ more staff and/or students, being able to do cutting-edge research, and having more opportunities to interact with others.

The *NZ Science Mathematics and Technology Teacher Fellowship* scheme supports the retention of teachers in the teaching and wider education arena and enables enhanced and innovative contributions to teaching and learning.

The great majority of tertiary students on the database of *Talented Young New Zealanders* are pursuing scientific or technological futures. A number of them have commented that it has been an involvement in the range of activities offered by the Society or other similar activities that has caused them to change their career plans back to science or technology.

A long standing proposal by the Society to examine the supply and demand for knowledge workers in New Zealand has not been accepted by government.

The journals respond to all capability needs as a consequence of accepting and publishing papers submitted by researchers for all relevant government-funded organisations.

Purchasing balanced portfolios of research within output classes

The *Marsden Fund* supports research of international quality, aimed at enhancing knowledge and understanding, and exploring new ideas. Ultimately, Marsden Fund research is likely to lead to new endeavours, although some high risk proposals are funded. Research is investigator driven, tends to be of a basic nature (although it is not exclusively so), and in its scale exists as projects rather than programmes. Funding between different fields is allocated according to demand, as measured by the number of quality proposals received. The assessment process explicitly considers the development of skills in New Zealand, particularly those of emerging researchers. The final range of projects selected by the Marsden Fund Council is diverse in its range of topics, varies from high to low risk, and includes significant capacity building.

The *Marsden Fund* does not seek specifically to balance the needs of new research providers against existing providers. Rather, the balance is between new researchers and more experienced ones. One successful means of doing this has been through the Fast-Start programme, which is available to researchers who have less than 7 years research experience since their PhD. Fast-Start applicants are judged on two criteria – merit of the proposal, and potential of the researchers to contribute to the advancement of knowledge. Standard applicants are judged on one further criterion – contribution to development or broadening of research skills in New Zealand.

NZ Science Mathematics and Technology Teacher Fellowships demonstrate balance over learning areas (disciplines/subjects), gender, geographic and socio-economic factors. The under-representation of Māori and primary school teachers is slowly being redressed.

The journals respond to the publishing requirements of the relevant government-funded organisations.

Running robust and transparent processes

All funds managed by the Society have independent external panels and use transparent, open selection processes. Selection criteria are well advertised and rigorous procedures are in place for avoiding conflicts of interest. The Society is very fortunate to have extremely high calibre people participating on the various panels. The Society has recently developed dedicated software for use in its administration of funds other than the Marsden Fund.

The Marsden Fund runs a two-stage application process. Preliminary proposals are assessed by eight panels of experts, who are chosen for their particular fields of expertise. Subject to the availability of qualified people, efforts are made to ensure that panels are as representative as possible, in terms of institution, geographical area, research experience, gender and ethnicity. To ensure that fresh perspectives are introduced to panels but that experience is maintained, about one-third of the approximately 60 panellists are replaced each year. Panellists serve for a maximum of 3 years,

although convenors (who are members of the Marsden Fund Council) may serve for longer. The same panellists assess full proposals after review by three or more expert referees. At least one of the referees for each proposal is not nominated by the applicant. At the end of the funding round, the panellists, many of whom also have experience of participating in reviewing applications for international funding agencies, are asked to suggest improvements to the process. The Marsden Fund Council finalises the list of successful applicants, which is subject to ratification by the Council of the Royal Society of New Zealand.

James Cook Research Fellowship recipients are selected by panels chosen to reflect expertise in the applicants' area and, where possible, gender and ethnicity. The panel short-lists up to three candidates who are then assessed by a Selection Committee. The Governor-General ratifies the decisions.

The *NZ Science Mathematics and Technology Teacher Fellowship scheme* has five panels of representatives of all stake-holders (hosts, teachers, teacher educators, teacher professional associations and tertiary education institutions) to make selection recommendations to a final panel comprising the chair of each panel plus the Education Electoral College Royal Society Council member.

Publishing validated and accredited research is integral for all academic journal publications. The Society journals use all the internationally recognised systems for validation of papers, including double refereeing, use of international reviewers, and national and international advisory boards. In addition, the Scientific Editors of the journals are all professional, permanent employees, ensuring continuity of quality and performance.

Meeting quality standards

The Society ensures that excellent standards of merit are maintained. Recipients of all funds managed by the Society are required to submit reports, which are evaluated to ensure that each contract is being fulfilled. The assessors also make site visits to monitor the ongoing progress of the research. No institutions or grantees receive funding until all regulatory requirements have been met.

The *Marsden Fund* has proposals assessed by national and international experts. In the 2002 funding round, 88% of the referees were from overseas, ensuring that the proposals were meeting international standards.

To ensure that quality research is undertaken by *James Cook Research Fellowship* recipients, the Academy Council of the Royal Society of NZ receives interim and final reports and general summaries and passes opinion to the Society on the quality and progress of the research. Any unsatisfactory performance will be conveyed to the researcher so that standards can be improved. The Manager administering the scheme has now introduced a monitoring visit during the term of each Fellowship, usually after 9 months.

The *NZ Science Mathematics and Technology Teacher Fellowships* selection process ensures that a high quality of award is maintained. This form of peer review is crucial to the maintenance of standards in the selection process.

For the Royal Society journals, reviewing processes, journal boards, and professional editors all contribute to the quality of the publications. This is further accredited by the positive rankings of the Science Citation Index.

Involving users and providers in strategy development

In the case of the *Marsden Fund,* the Marsden Fund Council decides the investment strategy. The Council is informed, in part, by the Marsden Fund executive, which maintains excellent relationships with providers, and with whom it exchanges information on ways of improving the process and the effectiveness of the investment. A strength of the fund is the direct contact of the executive with the researchers, particularly through monitoring visits. These visits, which sometimes include a member of the Marsden Fund Council, provide an opportunity for researchers to inform the fund of issues affecting their performance. The executive has also contributed to workshops and seminars on the Marsden process at various research institutions.

The *James Cook Research Fellowship* selection panels and selection committee provide advice on the process and on the broader strategy. Many Fellows also contribute advice and feedback on an informal basis but this will become more formal with the introduction of monitoring visits.

The *NZ Science Mathematics and Technology Teacher Fellowships* selection panels provide advice on the process and on broader strategy. Many Teacher Fellows and hosts have also contributed advice in an ad hoc fashion as issues arise. The Science and Technology Education Committee of the Society is also used for strategy consultations.

In its broader role under the 1997 Act governing the Royal Society, the Society undertakes wide and regular consultation with its 70 constituent science and technology organisations. The Society's strategic plan is developed collegially, and posted on the web for public scrutiny.

The journal editors regularly canvass their users with surveys and questionnaires regarding the journals quality, performance, and processes. Journal advisory boards also act in this capacity and assist in establishing Strategic Plans for the journals. Some boards have active email discussion groups to consider questions of strategy for individual journals.

Funding the full costs of RS&T

The level of funding offered to a successful applicant by the *Marsden Fund* Council is taken in the light of information about previous costs of contracted research in the different research areas and the funding requests per researcher time (FTE). The researchers' own budget priorities are also taken into account. Special attention is paid to those funding requests per FTE which differ markedly from the average to decide whether the divergence is justified by particular requirements of the project. Details of the final budget and the research programme are settled by negotiation. In those negotiations, the Marsden Fund is scrupulous in adhering to the principle of full cost funding.

NZ *Science Mathematics and Technology Teacher Fellowships* are accorded prestigious award status by the Ministry of Education, and so teachers are granted leave on full pay. Schools are awarded full costs for replacement of the teacher fellow. Host institutions may claim expenses towards hosting a teacher fellow. However, the level of expense claimed is regarded as an indication of the degree of support from the host organsation and is used as one of the criteria in the selection process. Most direct costs of the proposed activity are reimbursed to the host organsation, and a contribution to overhead expenses is usually claimed by hosts.

In operating the *Science and Technology Promotion Fund*, all projects involve cost-effective partnerships with other institutions. There has been a very satisfying degree of cooperation and goodwill.

Purchase Agencies are under instruction from the MoRST to full-cost fund projects. While this is adhered to in major funds such as the Marsden Fund, it proves inappropriate to do so in areas such as Science and Technology Promotion (a much smaller fund), or in scholarship schemes, where leverage is explicitly sought. MoRST may wish to review its instruction of full cost funding and consider whether an instruction "to ensure that a project is full cost funded" may be more appropriate.

Full costs are not relevant to journal publishing. However, the journals agree that full-cost funding should also cover the costs of transferring research results to end-users.

Responsiveness to Māori

The Royal Society acknowledges its obligation to operate all its activities in accordance with the Treaty of Waitangi. The Society recognises the need to ensure that Māori are aware of its various programmes, that these programmes are responsive to the needs of Māori, and that the processes associated with application, assessment, monitoring, and evaluation are appropriate.

In a significant initiative, the *Marsden Fund* and the *James Cook Research Fellowships* scheme have introduced a "Responsiveness to Māori" section on their application forms, to ensure that where appropriate, proper consultation with Māori takes place. In the 2003 applications to the Marsden Fund, 23% of all applicants considered that their research might have relevance for Māori, with the degree of Māori engagement ranging from an anticipation of Māori involvement or a consultation with the institution's Māori advisor, through to full Māori participation from the outset.

Māori are involved in 3.9% of current Marsden Fund contracts, with 1.9% of principal and associate investigators being Māori. Currently, there are 12 projects of specific relevance to Māori.

In the 2002-03 year 2.3% of the total funding has been spent on programmes covering issues of specific interest to Māori and a further 2.3% on additional research programmes involving Māori as principal investigators. That is, 4.6% of the funding is related to Māori either through the research topic or through enhancement of research experience and training.

Consultation with Māori is not expected, and is not appropriate, for proposed projects where no specific interest for Māori can be identified. If, however, the research topic involves Māori people or is relevant for Māori (for example, it involves taonga, sacred objects or sites, resource use, investigations of native fauna, or had the potential for Māori capacity building), full consultation by applicants is required.

With regard to the *NZ Science Mathematics and Technology Teacher Fellowships* scheme the number of Māori teacher fellows is slowly increasing. The involvement of those Māori Teacher Fellows in promotion of the programme to their colleagues will produce further increases. The Society also intends to seek assistance from the mentoring/support schemes run from Victoria University of Wellington and the University of Auckland to encourage Māori teachers to apply.

All educational programmes, resources and other opportunities for students and schools are constantly promoted to Māori and Pasifika students and kura kaupapa. Māori pupils (and those of other ethnicity) are selected for various science and technology events managed by the Society.

There is no particular demand to change journal publication design or process in response to the needs of Māori at this time.

Increasing global connectivity

While New Zealand is a modest player in international science and technology the quality of its science and technology capability, recognition and alliances continue to be important. New Zealand's international links have increased significantly over the past five years.

The *Marsden Fund* Council believes that strong international linkages are vital to New Zealand research and, ultimately, to New Zealand's overall well-being. It believes that these linkages can be very effectively pursued by individual researchers, particularly where the New Zealand researchers are operating at a high international level. For this reason, the Marsden Fund Council encourages international activity, and funds it accordingly. The majority of *Marsden Fund* contracts do enjoy strong international linkages, through collaborations and through international conferences. It is a feature of Marsden research that it spawns much new international collaboration, beyond that visualised at the outset.

The Society has excellent links with overseas funding agencies, brought about by visits to these agencies by the Marsden Fund Chair and Manager in 2001. The Society is now part of a network for exchanging information and for access to advice about funding processes. In 2002, these links were enhanced by a visit to the NSF by the Society's Evaluation Officer, Dr Andrea Knox, and an invitation to an Executive Director of the Australian Research Council, Professor Lawrence Cram, to attend a Marsden Fund Council meeting.

All *James Cook Research Fellows* undertake collaborative research with overseas researchers, either visiting other countries for a short period, or hosting overseas researchers in New Zealand. Fellows also attend overseas conferences to promote their research and thereby increase global linkages and networks. With an increase in the stipend paid to Fellows it is hoped that this will encourage more Fellows to consider working overseas during their Fellowships.

Increasing global connectivity is not an important aspect for the *NZ Science, Mathematics and Technology Teacher Fellowship* scheme. However, occasional Fellowships have an international component and enable linkage between individuals which then benefit NZ teachers and pupils. A number of Fellowships also enable NZ teachers to attend and, in some cases, contribute papers to, international conferences.

By their very nature, the programmes of the *Science and Technology Promotion* activities increase global connectivity. This year, speakers from Britain, USA and Australia have visited New Zealand. And as a result of the DNA50 programme, Professor George Petersen gave a series of presentations

in Australia on New Zealand science, and Professor David Parry has been asked to give his presentation on Maurice Wilkins in London this month.

The *ISAT Linkages Fund* recipients undertake collaborative research with overseas researchers, either visiting other countries for a short period or hosting overseas researchers in New Zealand leading to ongoing collaboration.

Membership of international scientific unions continues to provide New Zealand researchers with a wide range of scientific information that is exchanged between affiliated countries while it also contributes to the expansion and development of New Zealand's knowledge-based processes and technologies. Attendance by New Zealand researchers at international scientific union meetings, congresses and/or assemblies also provides an opportunity for them to have an input at international meetings, into policy-making and the scientific work of commissions and working groups. Some hold senior positions in these groups. Participation also contributes to New Zealand retaining international credibility on the world scene as a scientifically and technologically advanced nation.

In furthering international linkages, the Society has mainly used its own resources to build close relationships this year with the Forum for European-Australian S&T (FEAST); the Forum for East Asian-Latin American Cooperation (FEALAC); and science agencies in Korea, China, France, Switzerland (CERN), and Chile. The society hosts an annual briefing on New Zealand science and technology for foreign Embassies and High Commissions.

Publishing the journals online undoubtedly increases the visibility of New Zealand research throughout the world. As a consequence, a growing number of papers are being submitted from such diverse countries as Turkey, Israel, and China, for example. Where these fit within the scopes of the journals, they are considered for publication. The journals also publish a large number of multi-authored papers, written by scientists from many countries who have contributed to the same research project. A number of papers are submitted from overseas authors who either work on projects relevant to New Zealand or have worked within New Zealand on a local project. By being sold to research libraries in many countries throughout the world, the journals play a significant role in disseminating new knowledge outside New Zealand.

Evaluating and reporting progress

The *Marsden Fund, James Cook Research Fellowships, Teacher Fellowships, ISAT,* and the *Contestable S&T Promotion Fund* all have monitoring procedures in place, and the information obtained is presented in this report.

The Society has an Evaluation Officer who has significantly increased the Society's evaluation capacity. For all the contestable funds, monitoring and evaluation procedures have been reviewed and where necessary new evaluation processes have been and are continuing to be put in place.

Regular user surveys and reviews, editorial board meetings, reports to MoRST, and internal discussion papers ensure that the journals' process and performance are continually under evaluation.

APPENDICES

APPENDIX I

Marsden Fund - Quantitative Indicators and Qualitative Achievements

1. Building New Zealand's Knowledge Base

1.1 Research Productivity and Dissemination

Table 9. Publications directly attributed to Marsden grants.*

	1994	1995	1996	1997	1998	1999	2000	2001	all
Papers	24	37	96	132	247	294	365	404	*1599*
Refereed Conference Proceedings	0	2	15	27	33	41	73	66	*257*
Book Chapters	3	2	6	11	25	25	40	46	*158*
Books	0	0	1	1	2	2	3	8	*17*
Edited Volumes	0	0	0	0	2	3	2	8	*15*
Reports	0	1	5	14	13	22	11	12	*78*
Total	**27**	**42**	**123**	**185**	**322**	**387**	**494**	**544**	**2124**

*either published or in press, and either wholly or partially attributed to the Marsden Fund

Table 10. Dissemination of Marsden results through conferences and other channels.

	1994	1995	1996	1997	1998	1999	2000	2001	all
Invited conference talk	0	1	15	32	44	59	77	77	305
Contributed conference talk	0	5	23	68	120	223	260	337	1036
Conference poster	9	8	43	110	163	144	94	77	648
Other[j]	0	1	0	6	10	9	21	22	69
total	**9**	**15**	**81**	**216**	**337**	**435**	**452**	**513**	**2058**

[j]Types of "other" output include: articles in non-specialist journals, gene sequences deposited in public databases, reagents developed, documentaries, radio interviews, websites, online databases, CDs distributed, and editorials and letters in specialist journals.

1.2 Research Quality

The quality of Marsden-funded research is ensured by rigorous selection procedures including national and international peer review. Measures of research excellence for contracts current in the 2002-03 year are as follows:

Papers on current Marsden contracts have been published in prestigious journals with high impact factors such as Nature Medicine, Science, Proceedings of National Academy of Sciences, FASEB Journal, EMBO Journal, Annual Review of Genetics, Physical Review Letters, Angewandte Chemie, Behavioral Neuroscience, Molecular and Cellular Biology, Oncogene, Journal of Neuroscience, Applied Physics Letters, Journal of Bacteriology, Plant Journal, American Journal of Physiology, Journal of Molecular Evolution, and Journal of Biological Chemistry.

The results from 72% of current contracts (excluding those awarded in 2002/03) have been presented at international conferences.

Of the 9 holders of the prestigious James Cook Research Fellowships with tenure during the 2002/03 year, 5 are principal investigators on current Marsden contracts.

Numerous prizes and awards to Marsden researchers, as listed in Table 12.

Table 11. Prizes and awards for Marsden-funded researchers

Marsden researcher	Contract	Distinction awarded
Professor Jeffery Tallon	IRL501, IRL801 IRL002, IRL101 IRL202	2002 Rutherford Medal
Prof Richard Sibson	UOO216	Awarded Fellowship of the Royal Society of London (FRS)
Prof Alan MacDiarmid	IRL101	Awarded Fellowship of the Royal Society of London (FRS)
Professor Bill Denny	CSO701, UOA203	Officer of the New Zealand Order of Merit
Professor Graham Nuthall	UOC707	Member of the New Zealand Order of Merit
Professor David Parry	MAU807, MAU903 MAU101	Elected Vice-President of the International Council for Science (ICSU)- first New Zealander to be appointed
Professor Harlene Hayne	UOO609, UOO907 UOO205	Elected as Fellow of the RSNZ, 2002
Professor Alison Mercer	UOO808	Elected as Fellow of the RSNZ, 2002
Assoc Prof Patrick Browne	UOA219	Elected as Fellow of the RSNZ, 2002
Professor John Flenley	MAU907	Elected as Fellow of the RSNZ, 2002
Assoc Prof David Kelly	UOC001 UOC103	Elected as Fellow of the RSNZ, 2002
Professor Robert McLachlan	MAU609 MAU202	Elected as Fellow of the RSNZ, 2002
Professor Robert Smith	UOO706 UOO803	Elected as Fellow of the RSNZ, 2002
Dr Graham Weir	IRL601, IRL901	Elected as Fellow of the RSNZ, 2002
Professor Tony Conner	CRO701	Elected as Companion of the RSNZ, 2003
Dr Hugh Bibby	GNS701, GNS202	2002 Shorland Medal (NZ Association of Scientists)
Professor Peter Kamp	GNS002	Mackay Hammer Award (Geological Society of NZ)
Professor Geoff Jameson	MAU008, MAU010 MAU205	2003 Royal Society of Chemistry Australasian Lecturer
Professor Margaret Brimble	UOA803, UOA118	First Australasian researcher to become a Novartis Chemistry Lecturer
Professor Ian Witten	UOW608, UOW805 UOW901	Namur award (International Federation of Information Processing)
Dr Bakhdyr Khoussainov	UOA017	NZ Mathematical Society Research Award (2002)
Professor Charles Higham	UOO516, UOO007	Awarded James Cook Fellowship, 2003
Assoc Prof Russell Gray	UOA110, UAO112 UOA217	Awarded James Cook Fellowship, 2003
Assoc Prof Andrew Pullan	UOA120	Awarded James Cook Fellowship, 2003
Dr Michael Berridge	MIM102	Awarded James Cook Fellowship, 2003
Professor Paul Callaghan	MAU704, HRT805, UOO911, VUW005	Chair of the Moderation Panel, PBRF
Dame Anne Salmond	UOA817	Chair, PBRF Social Sciences and Other Cultural/Social Studies Panel
Professor Vernon Squire	UOO607, UOO004	Chair, PBRF Mathematical and Information Technology and Sciences Panel
Professor Peter Walls	VUW803	Chair, PBRF Creative and Performing Arts Panel
Professor Patrick Sullivan	MAU603, MAU001	Chair, PBRF Medicine and Public Health Panel
Dr Roger Cooper	GNS001	New Zealand Silver Science & Technology Medal (RSNZ)
Dr Rupert Sutherland	GNS002	Hochstetter Lecturer, 2002 (Geological Society of NZ)
Dr Debbie Young	UOA102, UOA211	HRC Sir Charles Hercus Health Research Fellowship
Dr Mark Hampton	UOO903	HRC Sir Charles Hercus Health Research Fellowship
Dr Paul Bonnington	UOA825	Elected Vice-President of the Combinatoric Society of Australasia
Professor Colin Green	UOA601, UOA708 UOA007, UOA224	Guest Professor, Fujian Mediacl University, China
Robert McCormick	UOO214	RSNZ Hatherton Award (best paper by a PhD student in the physical sciences, earth sciences and mathematical and information sciences)

Table 12. A small sample of referees' comments on proposals which were successful.

Dr ……. has an international reputation that is second to none in the area
He is among the 2-3 leading world authorities
Dr ……. And a far-flung group of collaborators have created one of the leading international programmes
The potential of the research team is outstanding. The overall experience and record of achievement and innovation of the main and associate members of the research group makes this a formidable group
Professor …… has an excellent international reputation
This proposal is from a researcher, Dr ……., of the highest international standing
The principal investigator, Dr ……., is an internationally recognised expert

2. Enhancing Global Connectedness

The proportion of the contracts involving principal and associate investigators at more than one institution has risen steadily from 23% in 1995 to approximately 50% for the last 4 years (Figure 21).

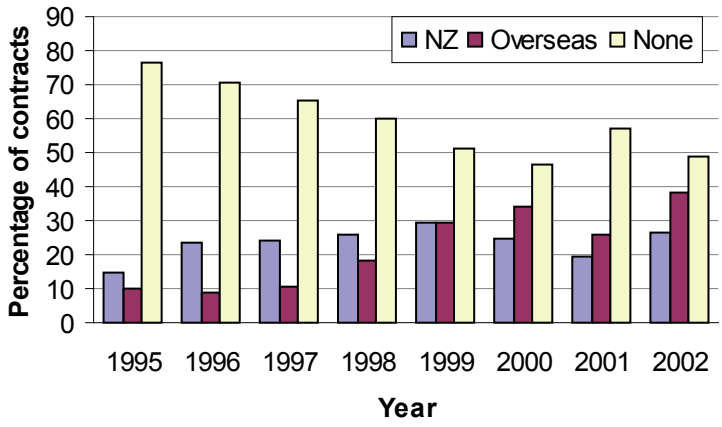


Figure 21. The percentage of contracts for which a principal or associate investigator is from outside the host institution, categorised according to whether the collaborator is from New Zealand or from overseas. The percentage of contracts having no such formal collaboration is also shown. The year refers to the starting date of the contract. The main features are an increase in overseas collaboration and a constant level of national collaboration.

The percentage of contracts that specifically include overseas principal or associate investigators is 38% for this funding round. Further collaboration occurs during the course of the research and the percentage of current projects with international collaboration is 65%. Since 1996, the percentage of contracts with a New Zealand collaborator from outside the host institution has been steady at 20-30%.

The sources of the New Zealand collaborations are shown in Figure 22. In the last 2 years of funding, collaboration with universities has increased while that with CRIs has decreased.

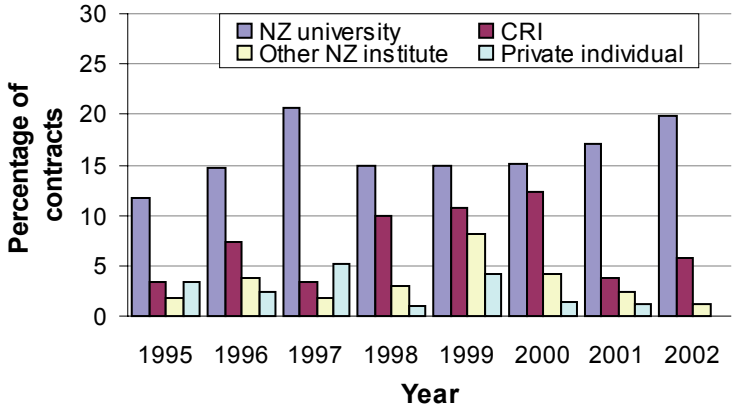


Figure 22. The percentage of contracts for which a principal or associate investigator is in New Zealand and outside the host institution, categorised according to whether the collaborator is from a university, a CRI, any other New Zealand institute or Government department, or is a private individual. A particular contract may be represented in more than one category.

New Zealand research benefits from Marsden-funded international collaboration by:

Using techniques, equipment or resources that are unavailable in New Zealand, often at no cost. Examples include:

- The use of nuclear facilities in the UK and Switzerland to measure properties of superconductors.
- The use of specialist surgical techniques in the UK to test antisense methods of treating spinal cord injuries.

Visiting overseas laboratories to learn new methods not available in New Zealand. Examples include:

- A PhD student visiting the National Institutes of Health, in the United States, to learn protein purification techniques in order to speed up the establishment of these methods in New Zealand.
- A postdoc visiting a laboratory in Bristol to learn a new method of radioactive dating.

Obtaining placements for promising New Zealand researchers with top overseas researchers. An example is:

- A student graduating with a PhD from a Marsden programme obtaining a postdoctoral fellowship at the University of Bergen, one of the world's leading centres for geometric integration.

Drawing on overseas researchers' knowledge by hosting conferences, workshops and individual visits. Examples include:

- A yearly meeting on mathematics in which New Zealand-born Fields Medal winner, Professor Vaughan Jones, hosts some of the world's best mathematicians to work with local researchers and students.
- The organisation of regular mathematical workshops to advance knowledge in the area of differential equations.

Hosting young researchers and students from overseas to build links for the future. An example is:

- A PhD student from the University of New South Wales spent 1 year contributing to a programme on understanding the variability of El Niño, using information contained in kauri tree rings.

Leveraging Marsden funding with overseas funding. Examples include:

- A PI's costs in travelling to overseas museums and libraries were met by international speaking engagements.
- A project attracted Wellcome Trust funding to support collaborative visits between New Zealand and Ireland, including the visit for 2 years of an Irish PhD student funded by his home university.

3. Building Human Capacity

3.1 Principal and Associate Investigators

The Marsden Fund has supported established researchers by:

- Funding contracts starting in the 2002/03 year that involve 112 principal investigators (all except one of whom are based in New Zealand) and 127 associate investigators (of whom 60% are based in New Zealand).
- Supporting contracts in the current year which involve 791 separate individuals as principal and/or associate investigators.

3.2 New and Emerging Researchers

The Marsden Fund invests heavily in emerging researchers. Evidence for this is:

18 Fast-Start contracts were awarded in 2002/03, to researchers who have had no more than 7 years' research experience since completing their Ph.D.

The Marsden Fund's contracts support approximately the same number of postdoctoral researchers as the NZ Science & Technology Postdoctoral Fellowships scheme, administered by FRST. For the 553 contracts awarded between 1996 and 2002, funding has been available for postdocs in 40% of them, providing the equivalent of 182 full-time 3-year appointments. In the 2002/03 year, the first year of new contracts has supported 28 FTE postdoctoral positions.

For the 553 contracts awarded between 1996 and 2002, funding has been available for postgraduate students in 54% of them. In the 2002/03 funding round, the first year of new contracts has supported 44 FTE postgraduate positions.

In 2002/03, 38% of all principal investigators and 27% of all associate investigators are within just 10 years of completing their PhD (that is, in most cases, are under 35 years of age). Last year, the corresponding figures were 38% and 24%, respectively. The participation of emerging researchers is significantly greater than would be expected from demographic considerations alone (Figures 23 and 24). Two years ago, before the start of the Fast-Start scheme, 27% of all principal investigators were within 10 years of completing their PhD.

Since 80% of contracts are in the science area, this distribution for principal investigators has been compared with the distribution of ages of New Zealand scientists, from *Profiles – A Survey of New Zealand Scientists and Technologists*[1]. [Note: the horizontal variables (*years since highest degree* and *age*, respectively) have been matched by assuming that the highest degree is obtained at 24 years of age.] The data show that the number of younger principal investigators is significantly higher than could be expected on the basis of demographics alone. However, experienced researchers also play a significant role.

[1] *Profiles – A Survey of NZ Scientists and Technologists*, J and D Sommer, The Royal Society of New Zealand, 1997

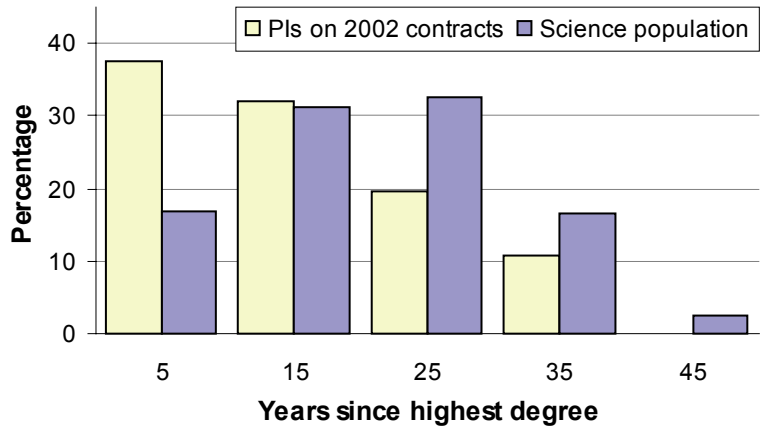


Figure 23. Experience of principal investigators (PIs) on contracts awarded in 2002/03, as measured by the number of years since the principal investigator obtained their highest degree.

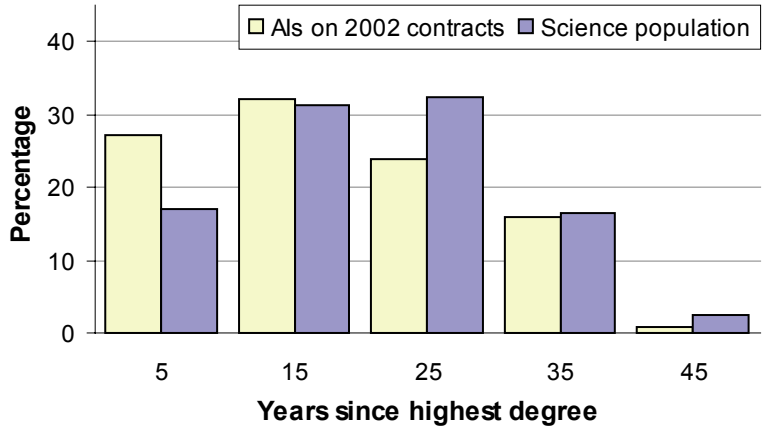


Figure 24. Experience of associate investigators (AIs) on contracts awarded in 2002/03, as measured by the number of years since the associate investigator obtained their highest degree.

3.3 Women Researchers

In 2002/03, 22% of the principal investigators on successful applications are women (Figure 25). Excluding the social sciences and humanities, the figure drops to 16%[1].

[1] Data from the 2001 Census shows that, excluding computer professionals and engineers, 27.5% of scientists are women. The corresponding figure for 1996 was 24.0%. Not all scientists are researchers.

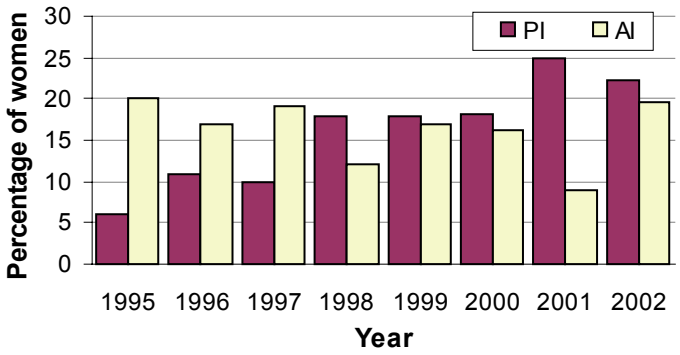


Figure 25. Percentage of investigators, principal (PI) and associate (AI), who are women.

3.4 Māori Researchers

For contracts active in the 2002/03 year, the percentage of principal and associate investigators who are Māori is 1.9%, although Māori researchers contribute to 3.9% of the contracts, across all 8 panel areas. In the 1997 Royal Society survey (referred to above), 0.7% of scientists were identified as Māori.

In the last year, the Marsden Fund has actively sought to increase the participation of Māori in fundamental research by:

- Including a "Responsiveness to Māori" section in the application forms.
- Publicising research conducted by Māori, or of specific interest to Māori.

In addition, the Society has endeavoured to ensure that Māori are represented on assessment panels.

APPENDIX II

Marsden Fund contribution to issues of public interest

Issue	No. of programmes[1]	Funding ($m)	Description
Genetics	110 (incl. 36 for use as a tool)	10.8 (incl. 3.2 for use as a tool)	In laboratory-based studies, understanding the way in which genes work, in relation to general cell biology, protein biochemistry, plant function and human health. Use as a routine tool to sequence DNA, for evolutionary, ecological and historical studies.
Environment	59	5.2	Programmes are investigating aspects of ecology, biodiversity, population genetics, plant physiology, oceanography and atmospheric science. Programmes of particular public interest include genetic studies of the threatened native black robin, the mechanics of soil erosion and the risk of horizontal gene transfer from genetically modified crops.
Health	66	6.9	Most programmes concentrate on fundamental aspects of biochemistry, cell biology and genetics. The focuses of the programmes include the immune system, the nervous system, disease-causing organisms, degenerative diseases, cancer research, drug synthesis, gene therapy, and statistical and computational methods.
Māori	12	0.69	Archaeology, language, Māori language newspapers, political representation, settlement, museum practice, rangatiratanga, and Ta Moko.
Children and adolescents	6	0.62	The development of memory and ideas of self, the influence of school experiences on the development of disabled children, and how students learn and acquire knowledge.
Natural hazards	9	0.75	Plate tectonics, volcanic and seismic activity.
Climate change	10	1.0	Programmes determining past climate (which provides information for today's debate on climate change), the mechanism by which the greenhouse gas carbon dioxide is permanently trapped by the oceans, El Niño history as recorded in tree rings, and processes affecting current global climate.
Information technology	19	1.4	Computer architecture, software, data transmission, virtual reality, machine learning, numerical computation and the theory of computation.

[1] Note: some projects fall into more than one category.

New materials and nanotechnology	24 (incl. 9 in nanotech)	2.6 (incl. 0.55 in nanotech)	Investigating new materials, including developing materials and material processes for nanotechnology.
Developmental biology	47	5.4	Investigating various aspects of plant and animal development (eg. muscle development, the control of flowering), as well as various aspects of learning and memory development.
Marine research	30	2.3	Studies of physical and chemical oceanography, biodiversity, ecosystems, ocean-climate interaction, geology, marine zoology, and biogeography.

APPENDIX III

Areas of strength in Marsden-funded research

Panel	Strengths
Biomedical Sciences (BMS)	Strong areas include protein structure and function, genetics and genomics, neurobiology, immunology, the nervous system, disease-causing organisms, degenerative diseases, cancer research, drug synthesis, gene therapy, and statistical and computational methods. Overall, modern biochemistry, physiology, molecular biology and cell biology are well represented. Many studies are multi-disciplinary.
Cellular, Molecular and Physiological Biology (CMP)	Plant molecular biology and pathology, protein biochemistry and structure, and molecular genetics.
Ecology, Evolution and Behaviour (EEB)	Molecular evolution, population genetics, marine ecology, plant physiology, and biodiversity.
Physical Sciences and Engineering (PSE)	There is a strong presence in materials science, in both chemistry and physics. Organic synthetic chemistry continues to be well developed, with potential biological and materials applications. There is particular strength in superconductivity and electron transport, soft condensed matter physics, and extreme low temperature physics (Bose-Einstein condensation). An interesting development is the number of projects that span traditional disciplinary boundaries, in bioengineering and biophysics.
Earth Sciences and Astronomy (ESA)	Strong areas are climate related research, especially climate processes and palaeoclimate, fluid physics, ice physics, astronomy, tectonics and crustal geophysics, oceanography, sedimentology, and palaeontology.
Mathematical and Information Sciences (MIS)	The Marsden Fund is supporting an impressive array of research across a wide spectrum of areas, including abstract analysis, biomathematics, combinatorics, computability theory, computational group theory, computer architecture and graphics, geometry, mathematical biology, numerical methods, and statistical methods and modelling.
Social Sciences (SOC)	Marsden funds a range of social science projects. Current projects include the disciplines of psychology, education, economics, human geography, anthropology, political science, and Māori studies. Aspects of New Zealand and Pacific history are well represented. Multidisciplinary projects have also been funded.
Humanities (HUM)	Strong areas include linguistics, New Zealand history, English theatre and literature, classics, cultural studies, Pacific studies, Māori studies, philosophy, ethics, and musicology.

Areas under-represented in Marsden Fund-funded research

Panel	Under-represented areas
Biomedical Sciences (BMS)	Studies on microbiology and infectious diseases are not well represented (this is also true in New Zealand as a whole). Other areas under-represented are dental science, nutrition and biomedical engineering.
Cellular, Molecular and Physiological Biology (CMP)	Microbial physiology, enzymology, psychological and behavioural genetics.
Ecology, Evolution and Behaviour (EEB)	Ecophysiology, ecosystem and landscape ecology, and global change biology/ecology
Physical Sciences and Engineering (PSE)	The lack of polymer chemistry remains a weakness in the portfolio, and probably reflects the low activity in this field in New Zealand. Physical and analytical chemistry, natural products chemistry, and catalysis are also under-represented. There are very few mainstream engineering projects, and optics and laser physics are weakly represented.
Earth Sciences and Astronomy (ESA)	There are gaps in meteorology and hydrology/groundwater.
Mathematical and Information Sciences (MIS)	Although there are many areas of research in which New Zealand has considerable expertise and researchers would have the potential to win support from the Marsden Fund should more awards be possible each year, there are no significant gaps in the range of areas currently being supported.
Social Sciences (SOC)	Sociology, law and business studies/management.
Humanities (HUM)	Visual culture, modern languages, religious studies and many areas of history are under-represented.

APPENDIX IV

James Cook Research Fellowships

- Professor Graham Le Gros (Health Sciences): Biology of asthma and the search for new therapies—completion date 30 April 2003;
- Professor Jos Arrillaga (Engineering Sciences and Technologies): Modelling of power systems under power electronic control—completion date 30 April 2003;
- Professor Judith Binney (Social Sciences): A history of the Urewera, 1820–1922—completion date 04/2003;
- Professor Peter Schwerdtfeger (Physical Science): The search for electroweak effects in molecules—completion date 03/2004;
- Professor Erik Olssen (Research of relevance to New Zealand and/or the South West Pacific): A history of New Zealand as an experimental society—completion date 06/2004;
- Professor Gaven Martin (Physical Sciences): Nonlinear analysis and geometry—extension to April 2004;
- Associate Professor Robert Poulin (Biological Sciences): Parasitism and the diversity of life—completion date 06/2004;
- Professor Charles Higham (Social sciences): The origins of the civilisation of Angkor—completion date 04/2005;
- Dr Michael Berridge (Health Sciences): Cell surface respiration in health and disease—completion date 03/2005.

Associate Professor Russell Gray (Biological sciences): "Untangling our past: language trees meet computational biology" and Dr Andrew Pullan (Engineering sciences and technologies): "Detailed computer modelling of gastrointestinal bioelectric activity" were awarded their Fellowships in early 2003 but did not start them until 1 July 2003. Completion date 30 June 2005.

APPENDIX V

Characteristics of Science, Mathematics and Technology Teacher Fellows

Table 13. Gender of Teacher Fellows, 1994-2003.

Gender	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Male (%)	65	74	47	67	38	50	50	46	54	50
Female	35	26	53	33	63	50	50	54	46	50

Table 14. School type of Teacher Fellows, 1994-2003

School	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Primary (%)	-	19	30	20	38	28	20	21	23	23
Composite	-	6	-	-	19	-	6	9	2	7
Secondary	100	75	70	80	44	72	75	71	75	70

Table 15. Percentage of Teacher Fellows by their school's decile rating, 1994-2003

Decile	1	2	3	4	5	6	7	8	9	10
Teacher Fellows (%)	10.5	8.3	6.8	12.7	12.4	6.5	13.1	10.6	11.2	8.0

Approximately 10% of New Zealand's schools fall into each decile.

Table 16. Geographic spread of Teacher Fellows, compared to New Zealand teaching population

Region	Teacher Fellows 1994-2003 (%)	NZ teachers 2001* (%)
Auckland	26.4	29.0
Bay of Plenty	4.9	6.7
Canterbury	14.9	12.1
Chatham Islands	-	0.02
Correspondence School	0.3	0.7
Gisborne Region	1.4	1.5
Hawkes Bay	3.8	4.5
Manawatu-Wanganui	6.6	6.3
Marlborough	1.0	1.0
Nelson-Tasman	4.9	2.3
Northland	3.5	4.3
Otago	9.0	4.7
Southland	2.1	2.6
Taranaki	1.7	3.0
Wellington Region	12.2	10.5
West Coast	0.3	0.8

* Ministry of Education Teacher statistics, May 2001.

APPENDIX VI

ISAT Linkages Fund

Table 17. ISAT Contracts and Values By Country 1999-00 to 2002-03

	99-00	00-01	01-02	02-03	Total	99-00	00-01	01-02	02-03	Total
Asia-Pacific:										
Australia	12	6	14	6	38	$19,360	$14,040	$27,460	$14,565	$75,425
Cambodia			1		1			$2,500		$2,500
Fiji		1	1		2		$2,000	$1,800		$3,800
Hong Kong		1		1	2		$3,000		$4,700	$7,700
India	1		1		2	$2,450		$2,200		$4,650
Japan	5	6	4	6	21	$16,130	$20,630	$10,100	$25,105	$71,965
Korea	2			5	7	$4,725			$34,000	$38,725
People's Republic of China	1	1	2	1	5	$2,590	$2,000	$5,800	$4,500	$14,890
Philippines			1		1			$4,000		$4,000
Singapore	2	2		1	5	$8,325	$5,500		$2,060	$15,885
Taiwan		1			1		$2,100			$2,100
Sub-Total Asia-Pacific	23	18	24	20	85	$53,580	$49,270	$53,860	$84,930	$241,640
South America:										
Argentina	1	3		2	6	$1,125	$9,950		$5,650	$16,725
Brazil	3				3	$10,695				$10,695
Chile	5	2	1	7	15	$15,635	$7,000	$3,400	$40,000	$66,035
Costa Rica		1			1		$2,925			$2,925
Mexico			1		1			$3,100		$3,100
Venezuela			1		1			$4,000		$4,000
Sub-Total South America	9	6	3	9	27	$27,455	$19,875	$10,500	$45,650	$103,480
NAFTA:										
Canada		4	4		8		$12,375	$12,420		$24,795
USA	24	17	20	17	78	$89,125	$52,760	$71,350	$58,600	$271,835
Sub-Total NAFTA	24	21	24	17	86	$89,125	$65,135	$83,770	$58,600	$296,630

	99-00	00-01	01-02	02-03	Total	99-00	00-01	01-02	02-03	Total
Europe:										
Austria		1			1		$4,430			$4,430
Belgium			3		3			$9,000		$9,000
Denmark	2	1			3	$7,945	$3,000			$10,945
France	1	6	1	4	12	$2,820	$17,440	$4,000	$14,140	$38,400
Germany	29	18	21	15	83	$100,230	$60,000	$66,330	$49,920	$276,480
Israel	2				2	$7,375				$7,375
Italy	1	1	1		3	$3,000	$2,800	$3,460		$9,260
Norway		1			1		$2,800			$2,800
Romania		1		1	2		$3,990		$3,500	$7,490
Russia	1	1		1	3	$4,725	$3,900		$3,230	$11,855
Spain				1	1				$3,600	$3,600
Sweden	1		2	1	4	$5,200		$6,800	$4,000	$16,000
Switzerland		1			1		$5,000			$5,000
The Netherlands	2		1		3	$7,425		$3,000		$10,425
United Kingdom	7	7	7	3	24	$19,080	$20,960	$24,600	$9,435	$74,075
Sub-Total Europe	46	38	36	26	146	$157,800	$124,320	$117,190	$87,825	$487,135
Other:										
Kenya	0			1	1				$4,500	$4,500
South Africa	1				1	$2,000				$2,000
Sub-Total Other	1			1	2	$2,000			$4,500	$6,500
TOTAL	103	83	87	73	346	$329,960	$258,600	$265,320	$281,505	$1,135,385

APPENDIX VII

International Scientific Union and Subscriptions

Scientific Union	Abbr.
International Council for Science	ICSU
Asian Crystallographic Association	AsCA
Federation of Asian Scientific Academies and Societies	FASAS
International Astronomy Union	IAU
International Commission for Optics	ICO
International Council of Associations for Science Education	ICASE
International Geographic Union	IGU
International Geosphere-Biosphere Programme	IGBP
International Institute of Refrigeration	IIR
International Mathematical Union	IMU
International Mineralogical Association	IMA
International Palaeontological Association	IPA
International Social Science Council	ISSC
International Union for Physiological Sciences	IUPS
International Union for Pure & Applied Biophysics	IUPAB
International Union for Pure & Applied Chemistry	IUPAC
International Union for Pure & Applied Physics	IUPAP
International Union for Quaternary Research	INQUA
International Union of Biochemistry & Molecular Biology	IUBMB
International Union of Biological Sciences	IUBS
International Union of Crystallography	IUCr
International Union of Geodesy & Geophysics	IUGG
International Union of Geological Sciences	IUGS
International Union of Microbiological Societies	IUMS
International Union of Nutritional Sciences	IUNS
International Union of Radio Science	URSI
International Union of Soil Science	IUSS
International Union of Theoretical & Applied Mechanics	IUTAM
Scientific Committee on Antarctic Research	SCAR
Scientific Committee on Oceanic Research	SCOR
Scientific Committee on Problems of the Environment	SCOPE
Scientific Committee on Solar-Terrestrial Physics	SCOSTEP

APPENDIX VIII

International Financial Support for Travel

Partial financial support to attend international congresses/meetings/symposia etc. was provided to the following:

- Dr Gerald Tannock, University of Otago, to attend the International Union of Microbiological Societies in Paris, France, July 2002;
- Dr Fred Davey FRSNZ, Geological & Nuclear Sciences, to attend the Scientific Committee on Antarctic Research General Assembly in Shanghai, China, July 2002;
- Dr Jill Stanley, HortResearch, to attend the International Horticultural Congress in Toronto, Canada, August 2002;
- Professor Rob Goldblatt, FRSNZ, Victoria University of Wellington, to attend the International Mathematical Union General Assembly in Beijing, China, August 2002;
- Dr Neil Thomson, University of Otago, to attend the International Union of Radio Science General Assembly in Berlin, Germany, September 2002.
- NZ Institute of Agricultural Science to assist with the travel expenses to New Zealand in June 2003 of international speaker Professor Tom DeGregori, University of Houston, USA;
- Dr Nick Edgar, Landcare Trust, to assist with his attendance at the workshop on Science and Social Responsibility in Garrison, New York, USA in June 2003;
- Dr David Rhoades, Geological & Nuclear Sciences for attendance at the International Union of Geodesy and Geophysics General Assembly in Sapporo, Japan, July 2003;
- Dr Graeme Blick, Land Information NZ for attendance at the International Union of Geodesy and Geophysics General Assembly in Sapporo, Japan, July 2003;
- Dr Pam Kilmartin, University of Canterbury for attendance at the International Astronomical Union General Assembly in Sydney, Australia, July 2003;
- Dr Alan Palmer, Massey University for attendance at the International Union for Quaternary Research Congress in Reno, Nevada, USA, July 2003;
- Professor Graeme Wake, University of Canterbury, for attendance at the Industrial Mathematics Initiative 2003, in Korea, in July 2003;
- The University of Auckland to assist with the NZGS2003 Graduate Student Prize to be presented at the NZGS2003 conference in July 2003;
- Travel assistance to Professor Paul Jowitt, Heriot Watt University, Edinburgh, Scotland, to visit New Zealand in November 2003.

APPENDIX IX

International Financial Support for Seed Funding of International Symposia/Workshops

Financial assistance has been provided to the following:

- 10th International Symposium on Deep Seismic Profiling of the Continents and their Margins – Taupo, January 2003;
- NZ-Korea Bilateral Symposium on Advanced Materials and Nanotechnology – Wellington, February 2003;
- International Astronomy Union (IAU) 193: Variable Stars in the Local Group – Christchurch, July 2003;
- 18th International Radiocarbon Conference to be held at Te Papa, Wellington, in September 2003;
- International Tsunami Workshop to be held at the Michael Fowler Centre, Wellington, in September 2003;
- 4th International Conference on Applications of Stable Isotope Techniques to Ecological Studies to be held at Te Papa, Wellington, in April 2004;
- 8th International Global Atmospheric Chemistry Science Conference to be held in Christchurch, in September 2004.

APPENDIX X

Contestable Fund for S&T Promotion

Summer of Discovery
Australis Group Ltd
Project leader: Vicki Martin
Awarded: $85,000

The Summer of Discovery 'Summer Fun Kit' contains a video and activity book which are full of exciting experiments, fun-filled field trips and adventures to excite and inspire children aged 10-12 years and their parents about science and technology. A zany professor and his sidekick (animated character) present topics in science and technology. The video and workbook will be made available, for a minimum charge, through Video Ezy stores.

Present status:
Since its commencement, this exciting project has raised extensive additional sponsorship and expanded its scope and product. The video has been filmed and produced using Jason Gunn as the presenter. 10,000 activity books, 2,500 posters and video covers have been printed in full colour. TVNZ is interested in using the video as part of its children's broadcasting. Excellent feedback has been received from schools, community groups and media. The video and activity books will be placed in Video Ezy stores in November 2003.

Science Role Model Calendar
Capital City Science Educators Association
Project leader: Doreen Gates
Awarded: $40,000

Production of a calendar/monthly planner available for display in every intermediate and secondary science classroom in New Zealand. Each of the twelve calendar pages will display a large colour photograph of scientists at work with accompanying poster text. Emphasis will be placed on youthful role models representing a multicultural heritage and the interrelated role of the business and public sector science will be clearly illustrated. The contexts chosen will have meaning and appeal for a teenage audience.

Present status:
8,500 large full colour 'Matariki' calendars were printed and distributed to all composite, intermediate, secondary and area schools in June 2003. The 12 role models featured covered a wide spread of gender, ethnicity and science backgrounds. An evaluation of the project including feedback from the schools is due in October 2003.

Integrated Garden Management : The Science Behind Your Garden
HortResearch/Crop and Food Research
Project leader: Damian Coup
Awarded: $60,000 (2002/03), $40,000 (2003/04)

The Science Behind Your Garden will promote science to gardeners from all walks of life. The project aims to work mainly through garden centres to capture gardeners' attention and bring science into their lives. 1000 staff in garden centres will be trained by scientists to help the general public understand pests, diseases and soil health. Audiences will be reached using a range of communication techniques based around resource kits.

Present status:
This two year project is progressing on schedule. Resource kits for garden centre staff and handout cards have been designed and produced. These kits will be tested at Atholl McCully's Garden Centres during October to December 2003. Kits will be introduced in a staggered release which will enable improvements to be made according to the public and garden centre staff response. (NB: It should be noted that the original project leader was killed in the air crash in June 2003. This sad loss was recognised by the entire New Zealand science community. The fact that this project is still on schedule and continuing to achieve its objectives is due to the highly professional response of the project team.)

Quickest, Strongest, Smartest: New Zealand Robotic Olympics
Massey University
Project leader: Chris Messom
Awarded: $37,470

This project will be a first in a series of annual nationwide robotic competitions open to members of the public in particular secondary and tertiary students. Cheap robot starter kits and guides will be made available but individuals will be free to use their creativity to design their own solutions.

Present status:
Following the regional competitions, the national finals were held in Palmerston North in September 2003. Over 300 people attended the event with competitions for schools, community groups, students and adults. There was widespread media interest and coverage of the event. Evaluation and a final report of the project is expected in November 2003.

SciBoards
New Zealand Association of Science Educators
Project leader: Ian Milne
Awarded: $53,000

Sciboards will be a popular science insert in the Hubbards cereals produced for children. Each Sciboard will contain information on the work of scientists (with a focus on younger scientists), examples of the application of research findings in a form easily processed by both young and adult, and activities, puzzles and competitions for the children.

Present status:
7 issues of Sciboards have been prepared and printed and are being inserted into 125,000 Hubbard cereal packets from June 2003. Feedback from intermediate children in term 3 SciBoard 1 and 2 will be used to enhance the later SciBoards. Insertion expected to continue until early 2004.

Good Morning Science
Otago Museum
Project leader: Helen Horner
Awarded: $8,000

The ‘Good Morning Science’ project offers a variety of science programmes and presentations to stay-at-home parents/caregivers, community child caregivers and their charges at weekly morning sessions at the museum. Whilst the adult presentation is occurring, the children will be engaged and supervised by a second project person using science-orientated toys and activities. An activity will be provided for the adults to take home and use with other siblings in the household.

Present status:
This project was completed in October 2003. The project exceeded all expectations in popularity, attendance and feedback. 13 different topics were covered and the programme was run twice over 26 weeks. The take-up was overwhelming and the programme had to move to a larger hall and engage more staff. Good local media coverage was organised and excellent feedback was received from the participants.

Science and Technology Partnership Promotion for Porirua Intermediate Schools
Partners Porirua
Project leader: Michelle Robinson
Awarded: $10,000

This project is a partnership between Partners Porirua, science and technology based businesses in the Porirua region and Porirua intermediate schools that aims to enhance pupils' experience in science, mathematics and technology and help them realise their full potential. The year 7 and 8 students will be given an understanding of the applications of science and technology and how it relates to future career and employment choices. This will be achieved through a series of workshops, mentoring, industry site visits and presentations.

Present status:
Four science and technology based businesses in the Porirua area have committed to the project and over 50 students are participating. Site visits and workshops were organised in term 3. Students are working on projects which will be presented at functions in October/November 2003.

Stonehenge Aotearoa
The Phoenix Astronomical Society
Project leader: Richard Hall
Awarded: $56,500

This project, based in the Wairarapa, plans to build a working adaptation of Stonehenge to allow New Zealanders to experience for themselves how the technologies of these times were used and can still be used. A 30-metre diameter circle of 24 monoliths, capped with lintels will encompass a central design incorporating an obelisk sundial, meridian line and a solar and zodiac calendar.

Present status:
Detailed drawing and measurements have been completed and excavation work on the site has begun. The target completion for the building work is March 2004. TVNZ are filming a documentary of the whole project from start to finish. The site will be opened by Sir Martin Rees, Britain's Astronomer Royal.

Stokes Valley Science Initiative
Stokes Valley Rotary Club
Project leader: Phil Hankinson
Awarded: $25,000

The project is to develop a number of science and technology based exhibits to be installed in public places around the centre of Stokes Valley. Enclosed modules that can be user operated will be installed along with three dedicated sculptural style interactives. The project will place science on a parallel footing with the world of art of enable science to be admired for its beauty, knowledge and cause and effect. This science resource will be placed at the heart of a community bringing science into day to day life.

Present status:
Three interactive exhibits have been created and were placed in Stokes Valley town centre in September 2003. The opening received a lot of interest from the local community and media and the Stokes Valley Community Trust are raising further sponsorship to complete the exhibit 'walk' around the town centre. Evaluation and a final report of the project are due in October 2003.

APPENDIX XI

Journals Published by the Royal Society – Submission Trends

Background

With effect from 1 January 2003, all papers submitted to the New Zealand journals published by the Royal Society became liable for a $50 page charge (to a maximum of $500 per paper) upon publication. Previously, this charge was waived where the submitting author also subscribed to the journal: in general, authors chose this subscriber option as being the most favourable.

Page charges may be waived upon application where lack of funding or personal hardship make the charge a disincentive to publication. Initial resistance to the charges was expressed throughout the scientific community. In particular, authors found it difficult to pay page charges for work that was already underway or in preparation for submission. Thus, in these early years of page charges, many (funded) authors believe they cannot afford to submit to the Society's journals. This appendix examines the effects of the page charges on the submission rates to the journals over the first 6 months of 2003.

Submission trends

The number of submissions to the journals from 1990 to June 2003 are shown in Figure 26. *Note that the 2003 data is for only half a year*. Of particular relevance to this report are the submission trends over the few most recent years. These are discussed below on an individual journal basis.

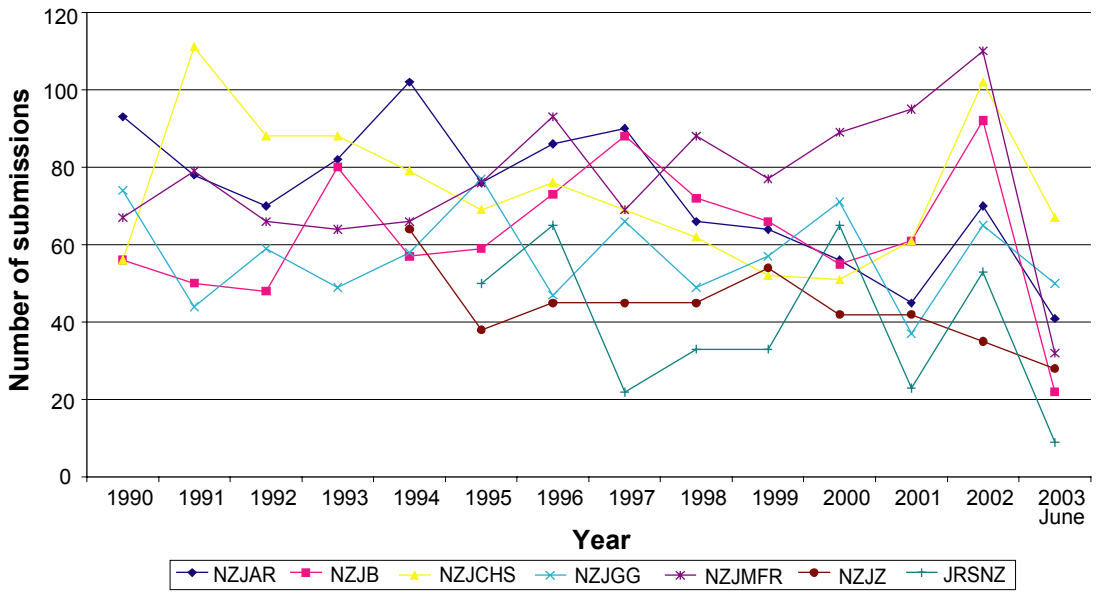


Figure 26. Journal submissions by year.

New Zealand Journal of Agricultural Research (NZJAR)

Traditionally, NZJAR has had a high number of annual submissions as a result of New Zealand's strong experimental pastoral history. Since 1997, submissions declined significantly as research efforts changed focus to laboratory-based, commercially contracted work. By 2001, submissions to the journal had become critically low, but strong promotion by editors and the editorial board was able to stop the slide. In 2002, submissions showed their first increase in 6 years.

New Zealand Journal of Botany (NZJB)

Submissions have generally been steady on this journal, with a characteristic oscillation every 2-3 years.

New Zealand Journal of Crop and Horticultural Research (NZJCHS)

Though always high, submissions to NZJCHS have been slowly declining. In 2000, this decline showed the first signs of reversal, and the upward pattern has continued through to 2003.

New Zealand Journal of Geology and Geophysics (NZJGG)

This journal has a steady level of submissions, with a regular oscillation from year to year. Submissions in 2001 were slightly lower than average.

New Zealand Journal of Marine and Freshwater Research (NZJMFR)

This journal has a good submission rate which has been increasing steadily since 1999, to a maximum (of all journals) in 2002. The high submission rate has led to the recent publication of large and extra issues.

New Zealand Journal of Zoology (NZJZ)

Although this journal has a reasonably steady rate of submission, they are generally low in number. This journal bucked the trend of all the other journals in 2002 in not recording a sudden increase in submissions during the months prior to the introduction of page charges.

Journal of the Royal Society of New Zealand (JRSNZ)

A usually low submission rate, but with wide oscillations every couple of years (possibly related to the publication of special thematic issues) has produced a "boom and bust" cycle for this journal. As at June 2003, only 9 papers had been received – an unusually low number, probably associated with rumours of financial difficulty.

Comment on submission trends

With only one exception (NZJZ), all journals recorded a dramatic increase in submissions during 2002 – the year preceding the page charges. The apparent reason being that authors submitted their papers early, in an effort to avoid charges in the following year. For the two smallest journals, NZJZ submissions declined, while JRSNZ did increase in 2002 (when a 500 page special issue was produced), but has since declined to lower than average.

Submissions to June 2003 show an apparent decline in papers submitted to some journals. However, for three of the journals (NZJCHS, NZJGG, NZJAR), numbers appear to be within the average to be expected at this time of the year. Of the other four journals, two (NZJB and NZJMFR) appear have been affected by the charges, as their decline in submissions is severe. This seems unusual for NZJMFR, as its prior submission rate was already very high, and its authors have not been outspoken against page charges, and subsequent to July ’03 (outside of the period covered by this report), the decline has reversed, suggesting that for NZJMFR, page charges caused no, or only a temporary reduction in submissions. NZJB's decline is likely a response (from authors failing to realise waiver possibilities) to the page charge, as up to 50% of the material it publishes derives from university departments, DoC, or other non-CRI sources where funding, or the payment of page charges, cannot be accommodated. For the remaining two journals (NZJZ and JRSNZ), the picture is not so clear: these journals already had relatively low submission rates, and the page charges would appear to have deterred authors from submitting in 2003.

Conclusions

- For all journals except NZJZ, submissions increased markedly in 2002 prior to the imposition of page charges.
- At June 2003, NZJAR, NZJCHS, and NZJGG have maintained an average rate of submissions and do not appear to have been adversely affected by page charges.

- NZJB and NZJMFR have had significant decreases in submissions since page charges applied. However, both journals already had exceptionally high submission rates in 2002, and for NZJMFR, submissions subsequently increased again.
- The decrease in submissions to NZJB appears to be related to the (perceived) inability of most authors to pay page charges.
- Both NZJB and NZJMFR have sufficient material in the system to enable publication to continue without effect. Special thematic issues of NZJMFR are also in preparation for which all publication costs are being met by the organisers.
- Low levels of submissions to NZJZ and JRSNZ have been exacerbated by page charges.
- Despite the adverse effects of page charges on some journals to date, these should be lessened over the longer term if sufficient funding is built into the research before publication.
- A clearer picture of the effects of page charges should be seen at the end of the calendar year when total number of all submissions is known.

APPENDIX XII

Journals Published by the Royal Society – Subscription Trends

Introduction

Against a background of steadily decreasing journal sales worldwide over the last decade, caused by a continuing squeeze on library funds, the international commercial journals continue to increase their subscription rates and force the cheaper regional journals "off the shelf". At the same time, all journals are learning to optimise the effects of online publishing, which offers an additional range of benefits to both subscriber and publisher in terms of speed of publication and delivery, ease of access, increased exposure of journal content, and potential decrease in user costs. The New Zealand journals published by the Royal Society began online publishing as a free service to print copy subscribers in 2003. The benefits of this, particularly the "free" individual access for members of large subscribing organisations (e.g., students and staff at universities, or staff at research institutes) were balanced by increases in subscription prices. For *individual* New Zealand subscribers, the price increase has predictably been a discouragement to subscribe, particularly as those who are also authors may now also pay page charges if not granted a waiver.

Percentage declines from 1996-2002 for each journal are: NZJAR: 30, NZJB: 7, NZJCHS: 29, NZJGG: 18, NZJMFR: 4, NZJZ: 24, JRSNZ: 0. In the 2003 subscription year to June, there was an average decrease for all journals of 17% (range 16-18%) over the previous year.

Although only halfway through the 2003 subscription year, numbers may not increase significantly from this time. Figure 27 shows that the overall rate of decline in subscriptions over the previous years has steepened for all journals in 2003 – the year of the increased subscription price. Even those journals which have shown a slight improvement in recent years (e.g., NZJB and JRSNZ) have been affected by a decrease in subscriptions in 2003.

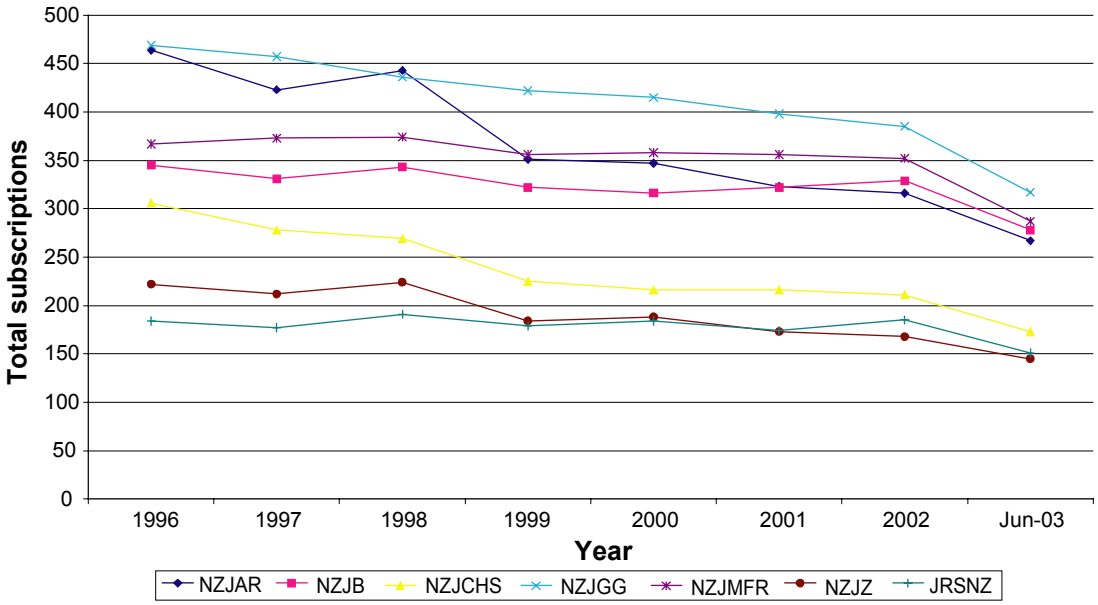
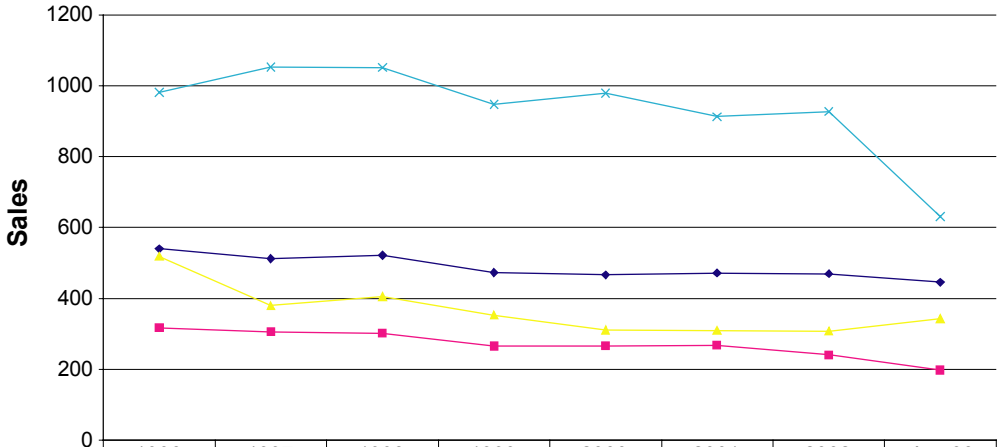


Figure 27. Journal subscriptions to June 2003.

As shown in Figure 28, from 1996 to 2002, subscriptions fell at an average annual rate of 1.9% (Allen Press), 3.4% (Eurospan), 5.9% (Asia/Australia), and 2.4% (New Zealand). But for the 2003 subscription year, the subscription decreases were 5, 18, +11, and 32%, respectively. This is unusual for two reasons: (1) the rate of decrease from New Zealand is very rapid (see below); and (2)

subscriptions in the Asia/Australia region have unexpectedly increased, reversing a previous slight downward trend.



	1996	1997	1998	1999	2000	2001	2002	Jun-03
US	540	513	522	473	467	472	470	446
UK	317	306	302	266	267	268	241	198
Asia/Aust	519	380	405	353	311	310	308	343
NZ	981	1052	1051	947	979	912	927	631

Figure 28. Subscriptions by country. Subscription trends since 1996 from the Society's four main sales areas: New Zealand, the Americas (Allen Press), Europe/Central Asia/Africa (Eurospan), and Asia/Australia.

Online subscriptions

From 2003, online subscriptions became available at lower cost than the print+online option. However, only 15% of subscribers within New Zealand have opted for the online-only subscription. For most individuals, the online journals are readily accessible through their institution's library subscription.

Comment on subscription trends

The price increases from 2003, and the "free" availability of the online journals to individuals, have reduced subscription numbers for all the journals, particularly from within New Zealand. Also, since 2003, there has been no obligation for authors to subscribe in lieu of page charges. Together, these explain a 32% drop (to June 2003) in New Zealand subscriptions over the previous year. This expected. It illustrates the effect of the Society's recent moves in online publishing, which make the journals available to a wider readership at little cost to the individual reader.

The decrease in New Zealand subscriptions has not been reflected in other countries outside New Zealand. Although there have been some decreases, particularly in Europe, the US market has remained fairly steady, and the Asia/Australia market has significantly increased by 11%. Again, this was not entirely unexpected. Overseas markets are more reliant on institutional subscriptions than on individuals. Although the increase in institutional rates is expected initially to reduce subscriptions (e.g., the important US market, where a 5% decrease is recorded), we forecast that the attraction of online availability included in the print subscription will eventually boost subscriptions. More work is needed to understand movement in the European market, which has always been very poor. The increase in the Asia/Australia market, however, is an unexpected bonus.

Conclusions

- The New Zealand market is predominantly via institutions to individuals who now have "free" access to online journals and therefore no longer need a personal subscription or have any obligation (as authors) to subscribe.
- Subscription numbers to all journals have decreased in the 2003 year by an average of 17%.
- Subscriptions decrease in 2003 is twice that of the previous 7 years.
- The decrease in 2003 subscriptions is highest from the New Zealand region (32%).
- Most overseas subscribers are institutions.
- The inclusion of online with print subscriptions is a strong incentive for overseas institutions to subscribe or renew their subscription.
- Increased subscription rates in 2003 have led to some anticipated cancellations, especially from Europe, but less so from the important US market, probably because the additional online access is considered to provide better value for money.
- The Asia/Australia market has reversed a 3-year trend by increasing by 11% in 2003.
- Despite an average decrease in subscription numbers of 17% in 2003, the price increases are sufficient to maintain subscription revenue, which is anticipated to increase by 18% in 2003.

APPENDIX XIII

Electronic Publishing of the RSNZ Journals

The government's policy on research espouses full cost funding, including the cost of publication of funded research. The Society's publishing objective is to make research published in New Zealand by the Royal Society widely available for low cost to the user. To this end, authors of articles published in the present print journals (available only on paid subscription to offset the cost of their production) are charged $50 per page, to a maximum of $500 per article. The free availability of the results of the research will be facilitated by the provision of research results through electronic publishing media. Electronic publishing enables wider dissemination of reviewed and validated scientific articles without the consequent costs of printing and distribution normally associated with journal publishing.

Use of journal website

The growing importance and desirability of electronic journal publishing can be illustrated by comparing the number of hits on the Publishing website between 2002 and the first seven months of 2003, and in particular, the number of "requests" for journal articles in PDF form. For the first seven months of 2003 there were 1,235,778 hits on the website (versus 918,462 for all of 2002), and 145,985 requests for PDFs (versus 65,637). This indicates an average increase in the publishing website usage of 230% in 2003, leading to an average increase in PDF requests of 381%. This is even more remarkable when we consider that the articles published in 2002 were (and still are) free to view; those published in 2003 are only available on subscription.

Need for digital journal archives

There are growing demands worldwide for archival journal information to be made available in electronic format. For example, the International Society of Horticultural Science (ISHS) has digitised its back issues, and has generated considerable revenue. The ISHS has also approached the NZJCHS regarding the possibility of assisting with the mounting of NZJCHS back issues on the Internet on their own website or establishing links to the NZJCHS web pages. Also, the *New Zealand Veterinary Journal* has produced CDs of its archives which are fully indexed and searchable. The Royal Society's digital archives span only the last two years (since electronic publishing of the journals began), yet the information contained in the journal articles will remain active for more than 10 years, as indicated by the citation half lives reported by the Science Citation Index. Thus, the Society regards upgrading past issues of the journals to digital format with some urgency. We are presently examining means of achieving this process with the assistance of other interested parties for historical information more than about 10 years old, but there is a need to convert the more recent material. Significant investment is involved in the conversion process, and funding assistance is needed in order to proceed.