THE ROYAL SOCIETY OF NEW ZEALAND

PROGRESS AND ACHIEVEMENTS REPORT

OCTOBER 2004

Promoting excellence in science and technology

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EXECUTIVE SUMMARY

The Royal Society of New Zealand is charged with promotion and advancement of science and technology in New Zealand. We have exceeded this goal in the past year, by enhancing the promotional outreach to communities both locally and internationally, from Tolaga Bay to Whitby, UK.

In its activities to promote and advance science and technology, the Royal Society of New Zealand (RSNZ) acts as an independent academy of sciences as well as a Government-supported research purchase agent. The two roles interlink so that both are performed particularly well, as each role leverages benefits off the other. The communications connections, for example, provide publicity for successful research programmes, which in turn provide stories to enthuse the public about science.

In this report we highlight our contractual responsibilities to the Ministry of Research, Science and Technology and also exhibit the connections between the different activities of the RSNZ and how they enable excellence in the promotion and advancement of science and technology.

The main arguments of this report:

The RSNZ Council, members and staff are passionate about the role of our organisation. We seek to enhance the understanding and critical awareness of issues surrounding science and technology, and to support the endeavour of research excellence as a means to reap high quality growth and innovation in New Zealand.

Our own limited resources are channelled to support the scientific and technological professionals who devote their careers to advancing the knowledge base in New Zealand. In addition, we enthuse a new generation of youngsters who will be the knowledge workers of our future.

We utilise the Government funding to maximal effect by promoting excellence in research through the Marsden Fund, Teacher Fellowships, James Cook Fellows, Award winners and outstanding young people.

The recommendations outlined in this report are summarised in priority order:

SCIENTIFIC EXCELLENCE

Priority 1

Our first priority is to the highly productive portion of the research community in New Zealand, and the critical needs of the Marsden Fund, which is considered by many as the nation's pre-eminent fund for research excellence. This is the only fund of its type in New Zealand, and the research community depends on it to support cutting-edge, investigator-led work, covering the breadth of the discovery-to-application spectrum of research and development. It supports highly talented and knowledgeable researchers, who demonstrate high quality and quantity of outputs. The Fast-Start awards also support newly emerging researchers who are likely to be our future leaders in their fields of endeavour.

There are four elements to the investment recommendations in our first priority. These are:

- increasing the Fund to support an additional 15 Fast-Start awards each year;
- increasing the Fund to restore its purchasing power which has been eroded by increased research costs, especially from the university sector;
- enlarging the Fund to increase the quantity of high quality research undertaken and the consequent expansion of the contribution to the knowledge base in New Zealand; and
- increasing the fee for administering the Fund to provide for the increased workload resulting from growth in the Fund, for enhanced evaluation and policy analysis capacity to support the Marsden Fund Council, as well as compensating for the increases in recent years in salaries and other costs of administering the Fund.

We recommend a total increase to the Fund in 2005/06 (in addition to increases already announced) with subsequent increases to enable the fund to achieve a $50 million benchmark within 3 years.

Funding at this level enables more young and emerging researchers to be supported by the Marsden Fund thereby contributing to the pool of skilled and talented New Zealand researchers, while increasing the overall effectiveness of this form of investment in New Zealand's future.

Priority 2

The James Cook Fellowships support the most skilled and talented people in New Zealand and enable them to achieve vastly greater outputs than they would otherwise produce while juggling management or administrative responsibilities. In past years, the stipends (including GST), have increased while the fund has not, so we have had to reduce the number of fellowships. Due to the decrease in the number of fellowships offered now, some fields of research are disadvantaged by a gap of up to 3 years between chances to apply for a fellowship. (In the next year, a review of the categories of research fields will be undertaken to ensure equitable access to fellowships regardless of field of research.) In addition, we are unable to offer third year extensions, although referred to in the Terms of Reference, to all valid applicants due to insufficient funds. Since the Government directive to fully-cost fund all research, it has become appropriate now to increase the fellowships to enable full-cost funding. The international benchmark for fellowships is a greater number than we currently support, longer tenure (of 4 to 5 years) and additional research support.

We recommend that the number of James Cook Fellowships be reinstated to 6, which is the optimal number of fellowships according to the current fields of research. We recommend that the tenure be increased to enable a third year extension for all applicants who qualify. We request an increase to enable full-cost funding. The overhead rates vary across research organisations, and we do not wish an applicant to be disadvantaged by the level of their institutes' overheads. Therefore, we request an increase that enables overhead rates regardless of the institute at which the James Cook Fellow works.

EXCELLENCE IN EDUCATION

Priority 3

Creativity in science and technology (CREST) is a programme piloted and run by the RSNZ for the past 15 years (mainly with sponsorship and without Government funding). It is highly successful at enthusing students about science and technology. It provides the pipeline of potential tertiary students, for example, who will undertake degrees in science and engineering. The RSNZ has strong links with the practitioners of science and technology who are mentors for students undertaking CREST projects. Thus, we enable the students' experiences to be authentic, increasing their verve for science and technology.

We recommend that the Government support this programme.

Priority 4

The New Zealand Science, Mathematics and Technology Teacher Fellowships is a flagship activity for the New Zealand Government. The quality of teaching in science and technology underpins the succession of

students into these fields, and this quality is enhanced by teachers gaining a strong, up-to-date understanding of scientific and technological practise. The RSNZ actively seeks to increase the science and technology host network, improve support for new hosts, improve the resource-development potential of teachers, increase representation of minority groups, increase teacher awareness and number of applicants to the fellowships, and improve the website that enables teacher–host connections and sharing teaching resources.

We seek an increase in the contract management fee this year, and in successive years, to enable us to carry out the above improvements to the programme.

PROMOTING A CULTURE OF AWARENESS

Priority 5 - The Science and Technology Promotion Fund

The Promotion Fund enables people to enhance public awareness of science and technology through grants that are coupled with sponsorship (either commercial or in-kind). The removal of the artificial caps on project grants two years ago has enabled the fund to support larger, more trans-national, projects that offer better value for money and receive greater publicity. The requirement for projects to obtain other sponsorship funding gives the Government a considerable additional return on its investment in the Promotion Fund. Evaluation of the Promotion Fund, which got underway during the second half of 2004, is providing interesting and new evidence which will inform any future Fund developments and policy changes.

The increased effectiveness of this fund and its ability to attract commercial sponsorship support the case for an increase of 20% to enable more projects to receive grants. Such an increase will not lower the standard, but will enable a greater number of high quality promotions to be supported and bring in more outside sponsorship.

Priority 6 - RSNZ Promotions Programme

There is a great deal of sponsorship leveraged by the exciting work of the RSNZ science and technology promotion programme, and we want to continue in this vein, remaining as independent as possible by gaining sponsorship from various sources. Continued Government support for staff time enables promotions to get off the ground so that sponsorship funds can be applied to tangible outputs such as prizes or events.

In 2005, our focus will be the Year of Physics, with a major education promotion called $E=mc^2$ The Story of the Universe. The New Zealand Institute of Physics and university physics departments have asked the RSNZ to coordinate events for their invited international scientists to contribute to this programme during their visits. Sponsors have already committed support for another nationwide video competition for schools. So there is ready money for the external costs, but not enough to staff the communications department at the level required to run such a large programme. While we will be hosting a Canadian intern at no cost for six months, we additionally require experienced help to run all these events. We recommend increasing staffing to previous levels, so we can maintain the same high level of activity as for the highly successful DNA50 and Transit of Venus campaigns. The more people we have, the more we can do and the more money we can leverage from other sources.

The RSNZ's Science Communicators' programme, currently completely run on a user-pays basis, now has an increasing database of people giving public talks on science and technology nationally. It is a great way to enhance the communication skills of scientists, and is going a long way to making the public more aware of science and technology. Those who currently miss out because they have no funding to pay for the course, such as students, should be supported through sponsored places. In addition, this course could be enhanced, with a module on dialogue, based on the research findings of recent studies of dialogue among scientists and society. We recommend support to offer 10 free places on the Communications Course for Ph.D. students and funds to develop a module that teaches dialogue skills to the research community, and expand the database.

REACHING OUT TO OTHER COMMUNITIES

Priority 7

International activities have a growing importance to the RSNZ, including the provision of information on international funding opportunities and the CoLab information clearing-house. Due to greatly increased commitments the funding of the clearing-house operations may need to be increased to allow the half-time position to become full-time once the NZ Counsellor based in Washington D.C. takes up his position.

In addition, the Government's extension of the ISAT Linkages Fund to three year grants means that there will be a significant shortfall in the Fund as the previously committed funding increases. If measures are not taken to smooth this increase, then pre-commitments will result in no funds available for allocation in 2008/09.

We recommend an increase of clearing-house operations in 2005-06 to enable a full-time employee, and an increase in the ISAT Linkages Fund per year to avoid the issue of previously-committed funding shortfall. Alternatively, the Society should be allowed to retain 15% of the fund per year to smooth out the bounce caused by these increases.

Priority 8 - NZ Journals Publishing

The key outcome of all research is the publication of results to share knowledge worldwide. New Zealand Journals Publishing provides a window for the world to see the excellent research undertaken in New Zealand as well as sharing international research of relevance to our region.

We recommend:

- Sufficient funding to enable open access to all and cover the full publication costs of the journals. Work is underway to estimate these costs precisely.
- Funds to cover the cost of page charge waivers for authors who have no research funding or personal funds.
- A new Business Development position to develop new initiatives during 2004/05, such as the establishment of a new online-only journal of Social Sciences. This person could usefully evaluate the changes in delivery and production methods of online journals.

Priority 9

Alpha and Gamma publications provide important resources for science and technology education in senior primary and secondary schools, as well as the rest of society. There are few science and technology resources in the Māori language available to Kura Kaupapa schools and other schools teaching in Māori. Alpha topics that inspire an interest in science and technology by Māori, including environmental protection and Māori science and technology role models, are particularly suitable. This Progress and Achievements Report highlights a recently piloted Alpha in te reo Māori, featuring Michael Walker. Extra funding for each Alpha is sought to cover the extra translation and production costs to produce the high quality Alpha in te reo Māori.

Priority 10

The Science and Technology Medals provided by the Government to recognise and honour our best scientists and technologists, are being enhanced by the RSNZ-funded Pickering Medal to recognise excellence and innovation in the practical applications of technology. This medal is designed to be complementary to, and slightly lower than, the Rutherford Medal which has taken on even greater prestige since its new naming, receiving more excellent nominations in 2004.

In early 2005, the RSNZ will undertake a review of all the medals and honours in New Zealand to ascertain the optimal suite of medals to honour and celebrate the diversity of effort by scientists and technologists in our country.

MĀORI STRATEGY

The Royal Society of New Zealand staff has supported the MoRST-led initiative to develop a framework designed to support investment in Māori research through Vote R, S&T.

In particular, the RSNZ desires to encourage participation by Māori, and awareness of Māori issues, in fundamental research. For example, we have instituted an initiative for 'Māori responsiveness sections' in the applications for research funding through Marsden grants and James Cook Fellowships. Both of these research funds are given according to the single highest goal – excellence in research – so that iwi-led research teams that successfully compete in this funding system receive the highest level of prestige and acclaim due to them.

There has been a variable proportion of research of interest to Māori undertaken through the Marsden Fund from year to year, due to varying numbers of teams applying. At the end of Appendix 1, there are data relating to Māori researchers funded by Marsden grants. Table 11 shows that there are 12 programmes of interest to Māori, and/or public issues relating to Māori, that are currently supported by Marsden funds. Māori studies is featured as an area of strength of the social sciences funded through Marsden.

The traditionally low proportional representation by Māori in science and technology, and the very recent increases in Māori representation are likely to mean that, in future, the proportion of Māori receiving these awards for excellence will increase. However, this could take several years as it takes a long time for the bright young scholars of today to develop an extensive track record that enables them to successfully compete against existing experienced researchers. One initiative recently piloted is the Fast-Start award. These are available to younger researchers without an existing strong track record, who have proven, rather, that they have strong future potential for excellent research. These types of fellowships are likely to support new and emerging excellent Māori researchers.

The RSNZ aims to increase the proportion of Māori among the NZSMT Teacher Fellowships. There are particular barriers that exist for Māori teachers, particularly Kura Kaupapa teachers, due to the resistance of their employers to allowing extended leave with pay. For example, it is simply too hard to find replacements of highly qualified te reo Māori teachers. The RSNZ is working through these issues to develop ideas that will overcome such barriers and enable equality of access to the fellowships by all people, by reducing the barriers put up (usually, but unwittingly) by their employers. In addition, the RSNZ Education Committee plans to hold a workshop supported by RSNZ's own funds, to liaise with the Health Workers Advisory Committee's subcommittee for Māori health and disability workers. This subcommittee has a goal to increase the number of Māori in health professions using a several-pronged approach, one of which involves improving Māori responsiveness by science and health education professionals in secondary schools, and encouraging tertiary education in medicine and related fields. This very specific goal is supported by the Education Committee's overarching goal of improving equality of access to, and interest in, science and technology among under-represented groups in New Zealand. The ideas from this workshop will be aired in a discussion document in 2005, and we expect several ideas to be in operation as soon as possible.

The RSNZ is interested in promoting S&T to Māori, as well as the wider public. The contestable Science and Technology Promotion Fund supported several excellent promotional projects involving S&T. Healing the Land is an activity that pioneers 'clean-up' technology and engages the local iwi community on whose land the clean-up site stands. The education, promotion and involvement have spread to the wider community. A video has been made and the promotion is expected to extend its reach further. Another Promotion Fund award was made to a SciTech/Te Tairau quarterly science insert in a young person's printed and online magazine. These quarterlies have been produced online in English and te reo Māori and the response from the readership has been positive.

The RSNZ's national S&T promotional activities have struck a chord in the past year with Māori students and others. The Transit of Venus schools' video competition was well supported and a team from Tolaga Bay Area School, which has a relatively large proportion of Māori students, won the prize of an all-expenses paid trip to England, to visit the site of Captain Cook's birth, in Whitby. The video showed the relation between the local community and the historical event of Captain James Cook's first arrival in Tolaga Bay. The enthusiasm of these young Māori students and their schoolmates was inspiring.

Publications in te reo Māori have begun this year, with the first Alpha science publication for schools in both our national languages. This Alpha features a Māori role model, whose story may inspire Māori students to be interested in scientific research. Professor Michael Walker tells his story including his whakapapa, his

struggle through school and university and the exciting way he decided on his research topic. He describes the culture shock of Māori students attending university, and how he piloted a programme to provide one-on-one support to improve retention of these students. He has witnessed the success rate of Māori students at Auckland University go from 30% to 80%, during the time he has worked there. Such inspirational stories may give impetus to Māori students to study, as well as showing us all that there is a wealth of opportunity to recruit and retain more Māori within the S&T system in New Zealand and our efforts to be inclusive and supportive will not be in vain.

THE ROYAL SOCIETY OF NEW ZEALAND – INTEGRATED PERFORMANCE

The Royal Society of New Zealand has two key roles. We are both an independent agency, operating under an Act of Parliament, and a purchase agent, administering over $40 million of funds for the Ministry of Research, Science and Technology and other Government and private funds.

In our role as an independent agency, we promote a critical awareness of the scientific and technological issues in New Zealand, we contribute to the education of the nation in science and technology, and we provide professional services to the research community.

In our role as a purchase agent, we deliver a variety of programmes for the Ministry of Research, Science and Technology, and other Government agencies. These programmes cover support for excellence in research and teaching, connections to international research communities, dissemination of New Zealand research and promotion of a scientifically aware culture.

As well as stating our contractual responsibilities, this report also highlights the underlying themes within the Royal Society's broad range of activities. These themes guide our practise, they form the basis for the quality of work that we do, and they are reflected in our standing among researchers in New Zealand and the wider New Zealand communities. These themes are:

Connection with the research base

The Royal Society currently comprises 311 Fellows, 45 Honorary Fellows, 50 constituent organisations and 1305 members. We act to represent their views to policy-makers on a national level and to provide expert advice to Government on both scientific issues and the performance of the science system. The extensive assessment, evaluation and site visits carried out as part of our delivery of the Marsden Fund give us in depth understanding of the research that we support.

National focus

We are the only science, mathematics, social science and technology education and promotional body with a national focus, allowing us to take on projects of national reach and to gather together partners to support larger and higher impact events.

Focus on excellence

Both the Marsden and James Cook programmes are aimed at supporting our brightest and most productive individuals. Both schemes are explicitly focused on developing new knowledge, human skills and expertise. While the Marsden Fund does not target applied research, the quality of the research is such that products and applications do arise.

A balanced approach

The Royal Society is seen as representing science and technology in general. We are seen as balanced and without a prejudiced stance on issues and organisations. Hence we have been asked to provide independent advice and to mediate between conflicting parties in the science system.

ACTIVITIES AND AIMS

Education and Awareness

We aim to inspire young people in sciences, mathematics and technology and to enable teachers to teach inspiringly and authentically. Our educational programmes include Teacher Fellowships, CREST, and the National Waterways project. Our awareness programmes include the Science Communicators course, the S&T Promotion Fund, the Science Meets Parliament talks, and our presentation of science to the media.

Supporting the Profession

We aim to build a vibrant and effective research community in a society where the contribution of science and technology is valued. Through our journals, we disseminate New Zealand research, and through other programmes we connect researchers together within New Zealand and abroad.

Supporting excellence

We aim to support, develop, recognise and celebrate excellence in research. The Marsden and James Cook schemes provide resources for our top researchers and the Royal Society medals honour the exceptional.

Science-Industry Interface

We aim to help build closer links between research and industry. Our programmes include the Science Communicating with Business course, aimed at overcoming the language barriers between scientists and the commercial world.

TRANSIT OF VENUS – AN EXAMPLE OF THE COHESIVE STRENGTH OF THE ROYAL SOCIETY

Before June 2004, a transit of Venus had not occurred for one hundred and twenty-two years. The Royal Society used this year's transit to inspire a programme of events focused on astronomy, Cook's voyage of discovery to witness the 1769 transit and the first encounters of Europeans and Polynesians in many countries including New Zealand.

Students, teachers and schools created videos about the Transit of Venus to enter a competition run by RSNZ. The top prizes were places for three school teams on an expedition to the UK to watch the 2004 transit from Whitby, the birthplace of Captain James Cook. 72 schools entered, far exceeding our expectations. Special events were organized, including farewelling the expedition at the Maritime Museum, live radio broadcasts and lectures at Te Papa, observing the transit from Whitby, and visiting Trinity College, Cambridge. A partnership with Radio New Zealand ensured coverage of the programme, the transit itself and the broadcasting of a six-part lecture series, all of which greatly multiplied the audience.

The team from Tolaga Bay received great support from their community, cultivating a sense of pride and aroha.

The partner website received over two million hits by July 2004, making available a huge amount of high quality information about Pacific voyaging, and the history of both New Zealand and astronomy. The partner website was funded by the Science and Technology Promotion Fund.

These kinds of programmes bring together all the different activities we do at the Royal Society:

James Cook Fellowships

A combined event was run at Government House to celebrate the James Cook Fellows and the Transit of Venus video competition.

Marsden Fund

Dame Anne Salmond's Montana prize-winning book "The Trial of the Cannibal Dog" was used as the key reference for the programme. The work that led to the book was funded by a Marsden grant.

The Science and Technology Promotion Fund

This fund supported the stand-alone Transit of Venus website, developed by Auckland University Centre for Distance Learning. This website was a new venture for the Centre. It proved so successful that they are using it as a model for further ventures, including the coming year's celebration of the International Year of Physics.

The Royal Society Communicators' programme

Lecturers for the Transit of Venus programmes were drawn from the Society's communicators database

Speaker's Science Forum

Paul Noon, of the British High Commission gave a presentation focusing on the relationships and connections developed by the Transit of Venus programme.

SUPPORT FOR THE TRANSIT OF VENUS PROMOTION

The Royal Society was successful in attracting sponsorship from:

- Freemasons New Zealand
- The British High Commission
- British Airways
- British Council New Zealand
- UNESCO

And support in kind from:

- The University of Auckland
- Vodafone
- Apple Computers
- New Zealand National Maritime Museum
- Royal New Zealand Navy
- Te Papa

The partnership with Radio New Zealand was highly successful. This range of sponsorship, support and partnership allowed a high output of S&T promotion and a very cost-effective return on the Ministry's investment in the Royal Society.

The Royal Society was able to run such a successful programme because we are the only science body with national focus, reach and comprehensive communication links. We are perceived to be objective, focusing strongly on communicating science, rather than promoting ourselves, hence many organisations see benefit in collaborating with us. We have demonstrated our ability to braid together separate activities, from our strengths in connecting researcher communities to local communities, to our ability to take excellent New Zealand research and present it in an engaging manner.

MARSDEN FUND

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.

Governance

The Fund is operated under Terms of Reference issued by the Minister of Research, Science and Technology. An independent Council, appointed by the Minister, has responsibility for allocating funds to projects and overseeing the progress of the research and researchers. The Fund is administered by the Royal Society of New Zealand which organises the selection process, manages the disbursement of funds, monitors progress and evaluates the outcomes from the research, and provides secretariat services to the Marsden Fund Council. A Memorandum of Understanding agreed between the Royal Society and the Marsden Fund Council describes the separation of the roles and performance expectations.

This section of the Progress and Achievements Report has been prepared with substantial input from the Marsden Fund Council, especially in respect of the ongoing development of policies to enable the Terms of Reference for the Fund to be successfully implemented. This section therefore is a joint report from the Royal Society and the Council.

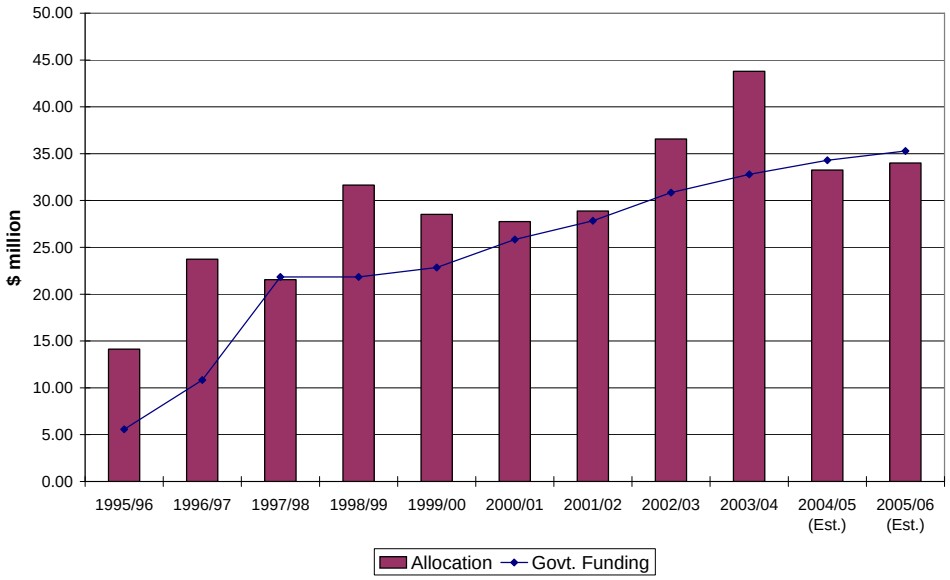
Scope and Scale

In 2003/04, the Marsden Fund operated as a separate Output Class under the Knowledge Goal of the RS&T system, with an investment budget of $32.739 million (21.7% of the Knowledge Goal investment, 5.88% of Vote: RS&T).

During the year, 395 research contracts were operational, covering the humanities, social sciences, sciences, mathematics and engineering. $33.513 million (net of returned funds) was distributed to active contracts.

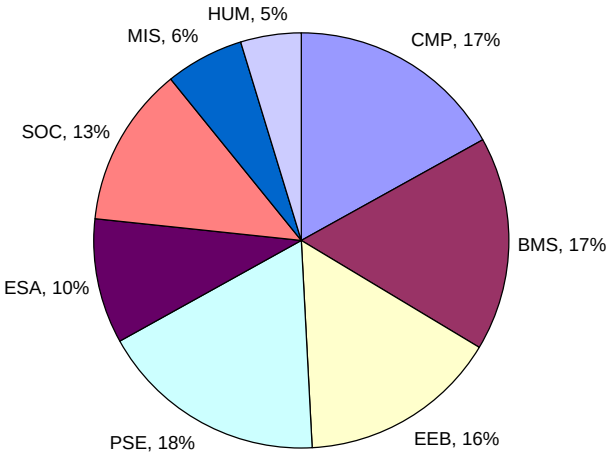
Each year, approximately one third of the total budget becomes available for new projects from expired projects and new money allocated to the Fund, however because projects do not normally commence until January each year, a surplus of approximately $7 million was held to cover the mis-match in timing between receiving the funds from the Government and its distribution to researchers. In 2003/04, on advice from MoRST that there was no longer a need to hold these funds, there was a special one-off release of funds allowing the allocation of $43.8 million to new projects. Figure 1 shows the trend in allocation amounts and Government funding in recent years. The amounts available for distribution from the 2004 funding round onwards will return to normal levels.

Figure 1. **Funds allocated to new Marsden Fund projects**



The distribution by research area of the $43.8 million funding to contracts commencing in the current year, is shown in Figure 2. Note that the proportion of the Fund allocated to each area of research is not predetermined. It is a consequence of the numbers of proposals received and their excellence relative to proposals not selected (i.e. their ranking).

Figure 2. **Funding by research area for new contracts in 2003/04.**



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, 49% of the funding is for the medical and life sciences, 34% for the physical sciences, earth sciences and mathematics, 12.5% for the social sciences and 4.5% for the humanities. The discipline spread is similar to previous years, except for the social sciences which increased from 9% last year to 12.5% of the total.

Special Characteristics of Marsden Funding

The Marsden Fund sets the standard in New Zealand for its portfolio of high quality research and for the rigour of the processes used to select projects for funding. 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.

One of the Fund's chief characteristics is the prestige that an award brings to recipients and their institutions. 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 ideas by the best or most promising people allows researchers to explore new areas of research, can lead to serendipitous findings and enriches the research environment in New Zealand.

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. Marsden contributes strongly to new knowledge as evidenced by citation rates that are nearly twice that for other New Zealand publications[1]. Marsden projects can lead on 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 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 University's 17 spin-out companies.

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. In addition, the Marsden Fund provides significant support for new and emerging researchers for New Zealand's research and innovation system. For new grants announced in 2003/04, the first year of funding provided for 63 postgraduate positions and 39 postdoctoral positions, and through the Fast-Start programme further 28 emerging researchers were supported.

Serious Issues Affecting the Fund

The Fund is facing some serious issues in the immediate future which will reduce the Marsden Fund Council's ability to deliver the Fund's objectives and may cause a loss of confidence in the Fund by the research community. The Fund is a victim of its own success in the sense that interest in its awards has jumped significantly in 2004, especially from emerging researchers since applications for Fast-Start awards rose by 77% during the year. Although the Government has provided modest increases to the Fund, the consequence of increasing interest is that a smaller proportion of new proposals can be funded. The same situation is anticipated for 2005 and future years. It has arisen because of heavy forward commitments on the Fund, the large increase in the number of applications being received and increased costs of the research being proposed. A further explanation of the situation and the reasons why it has arisen is given later in the 'Future of the Fund' section on page 26.

[1] Knox, A.L. (2004) "The Impact of Marsden-funded Research: a bibliometric assessment of Marsden-funded publications, 1997-2001". Available: http://www.rsnz.org/funding/evaluation/impact.php

With the amount of money able to be allocated to new projects in 2004/05 returning to 'normal' levels and taking into account the impact of increased research costs, it is expected that fewer than 71 new projects will be funded in 2004, the lowest level since 1997. Compounding this situation is the substantial increase in interest in the Fund by researchers. A major concern is that the overall cost of applying for funding will become too great preventing some of the best research ideas coming forward in the future. There is another concern sometimes expressed by applicants that as the number of funded projects reduces it becomes difficult for new researchers to obtain funding. The evidence from all recent funding rounds is that this is not the case and that more than 60% of the Principal Investigators (PIs) each year have not been a PI on a previous Marsden project.

In addition to seeking additional financial support for the Fund, the Marsden Fund Council is considering ways to address these concerns, including placing limits on the number of Marsden awards that can be held by a researcher at any one time and placing a cap on the maximum amount that can be sought for Standard grants. The Royal Society is also negotiating improved research cost structures with the major providers more consistent with the type of research undertaken with Marsden funding.

HIGHLIGHTS

Key Features for 2003/04

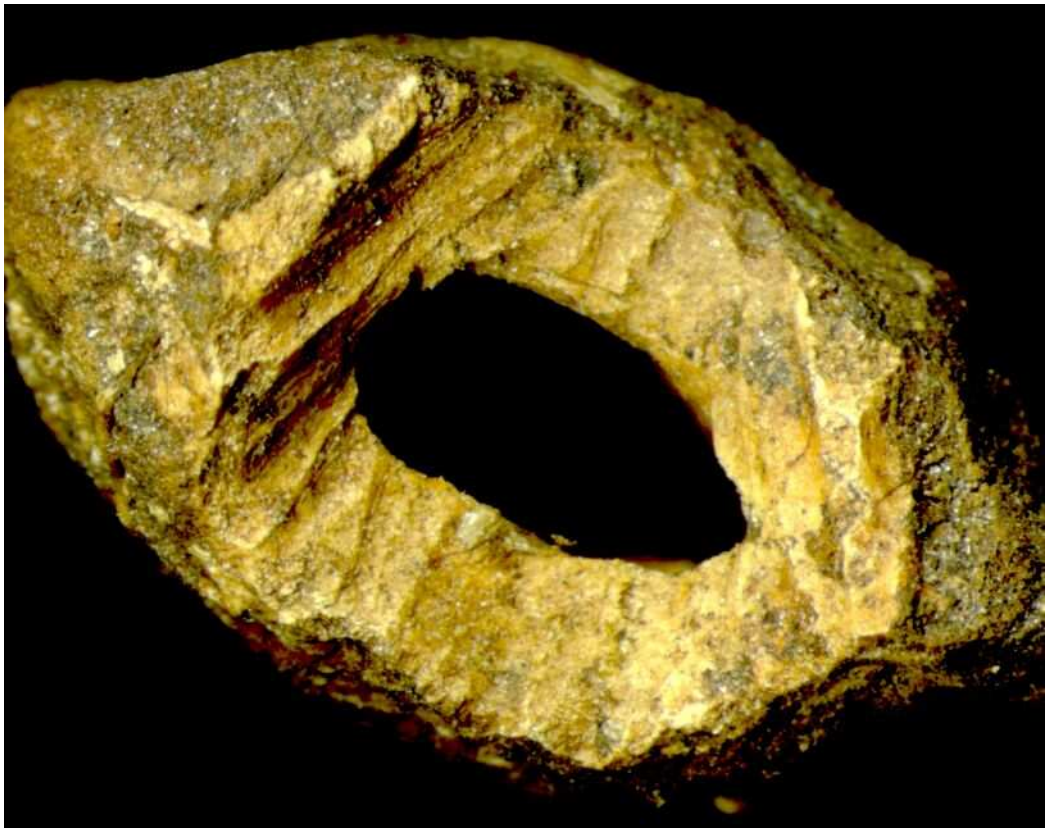
The Marsden Fund supports a diverse range of research, much of which is relevant to topics of general interest (Appendix II). A more detailed list of topics, listing areas where the Marsden Fund is strong, and also where it is under-represented, is included in Appendix III. Current areas of strength 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.

Breakthroughs - Fast-Start Research

The first 20 Fast-Start recipients have now completed their research, or are close to it, and the benefits of their work are now apparent.

Dr Janet Wilmshurst (Landcare Research) has cleverly used the ages of seeds which have been gnawed by kiore (Polynesian rat), to ascertain the time when humans first settled in New Zealand. She has assumed that kiore arrived with the first human settlers and, by radiocarbon dating seeds preserved in wetlands, has found that the first settlements occurred towards the end of the thirteenth century.

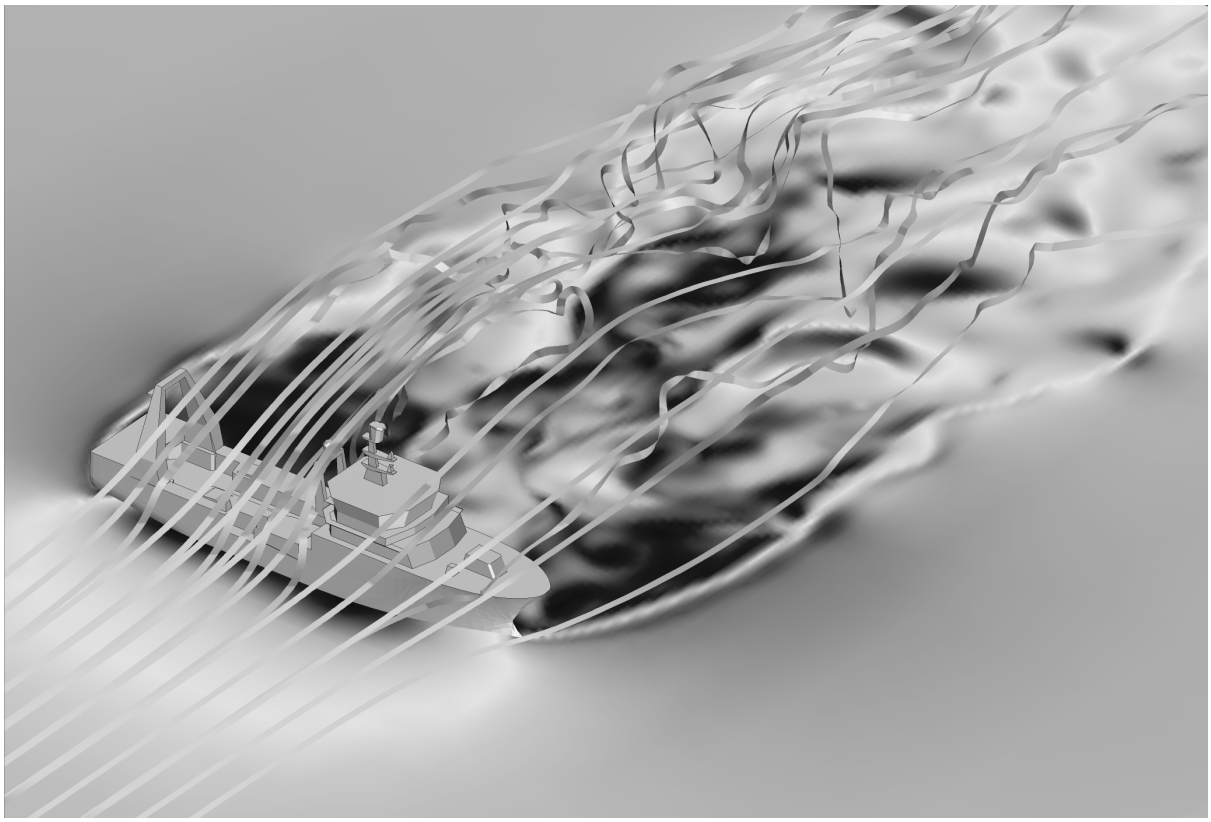
Figure 3. **Kiore teeth marks on seed case**



Dr Ken Carlaw (University of Canterbury) has measured productivity and technological change in a collection of 14 OECD economies (including New Zealand), and within the industries of New Zealand. Results have revealed that when investment quality change goes up (a measure of technological change), productivity decreases. This result supports theoretical predictions of productivity slowdowns when major new technologies emerge. It is only when the technology becomes established that productivity gains can be made. The research has resulted in a new theoretical model of technology driven growth.

Dr Stéphane Popinet (NIWA) has developed new mathematical and computational approaches to solve difficult fluid flow problems. His techniques are fast, and can cope with more complicated flows than previous models. They are applicable to scales as diverse as atmospheric flow in weather forecasting and wind flow around buildings.

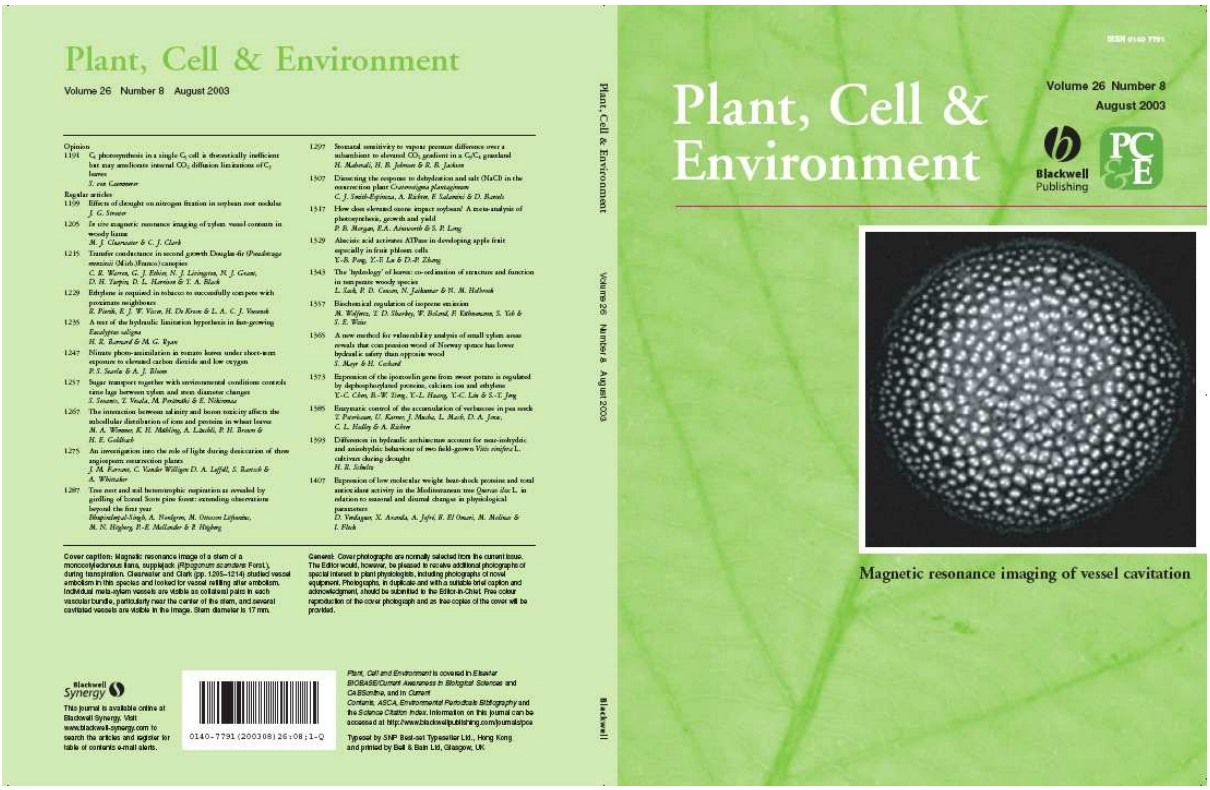
Figure 4. **Simulated flow around the NIWA vessel, RV Tangaroa**



Dr Paul Kench (the University of Auckland) has investigated the physical processes that control atoll reef island formation and change and has found that island shape is the most important parameter. He has generated a new theory on the formation of reef islands in the Indian Ocean, which suggests that the reefs may be able to cope with future rises in sea-level.

Dr Mike Clearwater (HortResearch) has investigated the mechanism of water transport in plants and, specifically, how plants cope with air bubbles in the xylem which appear as a result of drought. He has found that magnetic resonance imaging, in which New Zealand is a leader, is an excellent non-invasive technique for this study. So far, he has discovered, contrary to other researchers, that there is no indication that plants can eliminate the bubbles in the xylem. This work has been published as a cover story in *Plant, Cell & Environment*.

Figure 5. **Cover story in Plant, Cell & Environment**



The research programmes of Dr Thomas Proft and Dr Marti Anderson (both from the University of Auckland) were featured in the 2003 PAR. Dr Proft has discovered that superantigens are implicated in streptococcal toxic shock syndrome and has identified a route to a possible vaccine. Dr Anderson has applied innovative statistics to ecological communities in kelp, with the results indicating that these communities provide an indicator of the state of the environment.

Dr Angus McIntosh (University of Canterbury) has investigated the population ecology of stream insects that have larval and adult phases in their life cycles. He has found that predation by terrestrial wasps, and physical barriers such as culverts, affect the population distribution of caddis flies. His work shows that it is important to consider both the larval and adult stages of stream insects when investigating population dynamics, and has implications for the repopulation of urban streams and streams affected by mining and dairying.

Dr James Noble (Victoria University of Wellington) has investigated the way that objects in computer programs refer to other objects, and has designed methods to limit distant relationships which are a major source of problems in building correct software and improving it once it is built. Now a professor, Dr Noble has since gained another Standard Marsden grant which pursues this work further.

Dr David Hutchinson (University of Otago) has developed a new theoretical model for the behaviour of the Bose-Einstein condensate, a new state of matter that may provide an avenue into revolutionary new technologies such as quantum computing and atomic lasers. Other models have assumed that condensates form at a temperature of absolute zero, but in actual fact they form at slightly above zero. Dr Hutchinson's model takes account of this and has been able to resolve some anomalous findings that have troubled researchers since 1997.

In other Fast-Start projects Dr Mercedes Maroto Camino (the University of Auckland) has completed the manuscript of a book on the early voyages into the Pacific by Spanish and Portuguese explorers, and Dr Jun Yu (also from the University of Auckland) has developed innovative, new methods for fitting and analysing time series relationships of economic variables such as exchange and interest rates.

Breakthroughs - Standard Research

Associate Professor Mervyn Merrilees (the University of Auckland) is looking at the smooth muscle cells comprising artery walls. Disease-prone thickened artery walls contain fewer elastin fibres and increased levels of cholesterol-binding molecules; the team has used a chance finding to try to understand the mechanism by which a particular gene, called V3, effects these changes, in order to create disease-resistant blood vessels. They have carried out experiments in which the effect of the V3 gene has been nullified, creating arteries enriched in elastin. The team has funding from three sources to continue the work, which has implications for the treatment of atherosclerosis and lung disease.

Associate Professor Phil Yock's multi-institutional MOA team has recently made a startling discovery - the first definitive detection of a planet by gravitational microlensing and the most distant extra-solar planet yet detected.

Associate Professor David Wharton (University of Otago) has discovered that Antarctic nematodes appear to employ different strategies (dehydration, extracellular freezing, intracellular freezing) to cope with subzero temperatures, depending on the rate of freezing. He has found that the protein in nematodes which resists damage caused by freezing is dissimilar to those seen in other animals and is thus a new type of ice active protein.

Professor Barry Scott (Massey University) and his team have discovered the synthetic pathway of paxilline. This is an extremely potent toxin in mammals, made by some fungi including Penicillium; until now, its method of biosynthesis was not known.

Dr Henrik Kjaergaard (University of Otago) has made calculations which show that water dimers account for 1% of the atmosphere's total absorption of sunlight, and therefore must be included in climate change models. His results have recently been verified by a German experimental group, which has published its results in the prestigious journal, *Science*.

Professor James Sneyd (the University of Auckland) is using mathematical modelling to see how intracellular calcium waves are co-ordinated into intercellular waves, which in turn control the secretion of enzymes. He has successfully modelled the propagation of waves within the pancreas, which produces digestive enzymes. This is fundamental research which, in time, may contribute to improvements in clinical practise.

Professor Dame Anne Salmond (the University of Auckland) won the non-fiction category of the 2004 NZ Montana Book Awards with "The Trial of the Cannibal Dog: Captain Cook in the South Seas". Professor Vincent O'Sullivan (Victoria University of Wellington) was also nominated for the biography "John Mulgan – Long Journey to the Border".

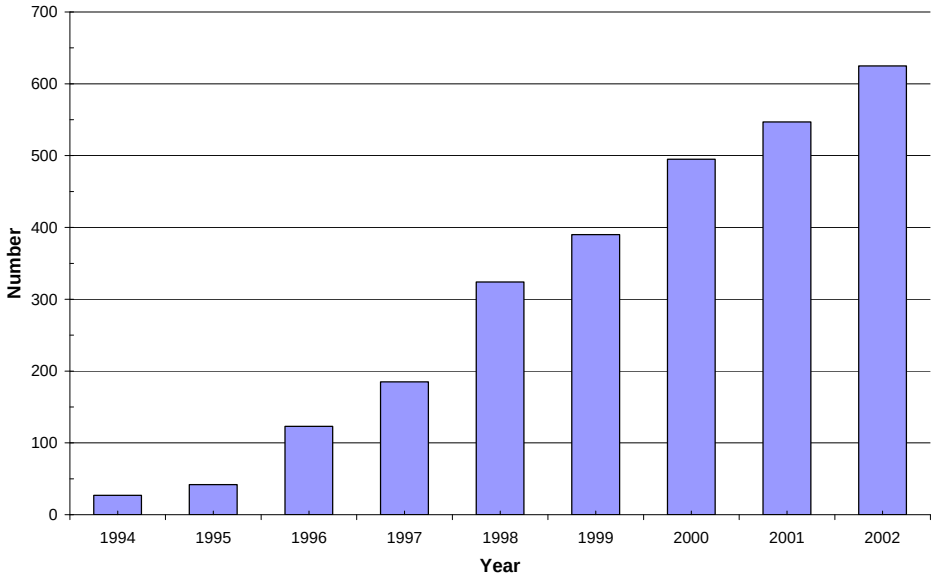
PROGRESS AND ACHIEVEMENTS EVALUATION

BUILDING NEW ZEALAND'S KNOWLEDGE BASE

Productivity

A bibliometric study has been conducted to count the number and type of Marsden publications, including those that have arisen since grants have finished[2]. The study covers the years 1994-2001 and shows that the annual number of publications has increased steadily in that time, from 27 to 544, the majority of which are journal papers (Appendix I, Table 12). Publication figures for 2002, compiled from contract annual reports, show that the trend of increasing numbers of publications is being maintained (Figure 6). In 2001, Marsden accounted for 7.7% of all New Zealand research publications.

Figure 6. **Number of publications per year funded by Marsden.**



In comparison to other New Zealand schemes, the Marsden Fund produces a high number of articles per dollar spent. In 2000, the Marsden Fund produced 13 articles per million dollars awarded in that year. This compares to the FRST figure of 5 peer reviewed articles per million dollars of FRST funding in 2001/02[3], and the NZ figure of 6 articles per million dollars of GovERD[4] and HERD in 2000.

Quality

The quality of Marsden proposals is ensured, in part, by peer review. The Fund aims to have each proposal refereed by at least 3 specialists, of whom 87% in 2003/04 were from overseas. Only proposals which meet high international standards are funded.

A widely accepted measure of research visibility and quality is the number of citations to research articles. Articles arising from Marsden projects are cited 1.7 times more often than the average for NZ-authored articles. This can be compared with the Australian Government's Discovery Project grants, which are similar to Marsden in that they fund investigator-led projects in fundamental areas of research. The citation rate for Discovery Projects is 1.2 times higher than the Australian national citation rate[5].

[2] The full report is available at: http://www.rsnz.org/funding/evaluation/impact.php
[3] Foundation for Research, Science and Technology, 2002, 2002/03 Outcome Indicator Returns. Available at: http://www.frst.govt.nz/Evaluation/ProviderIndicators.cfm
[4] GovERD – NZ Government expenditure on R&D; HERD – Higher education expenditure on R&D
[5] Bulter, L. 2004, "ARC-supported research: the impact of journal publication output 1996-2000", ARC, Canberra, Australia. Available at: http://www.arc.gov.au/pdf/arc_supported_research.pdf

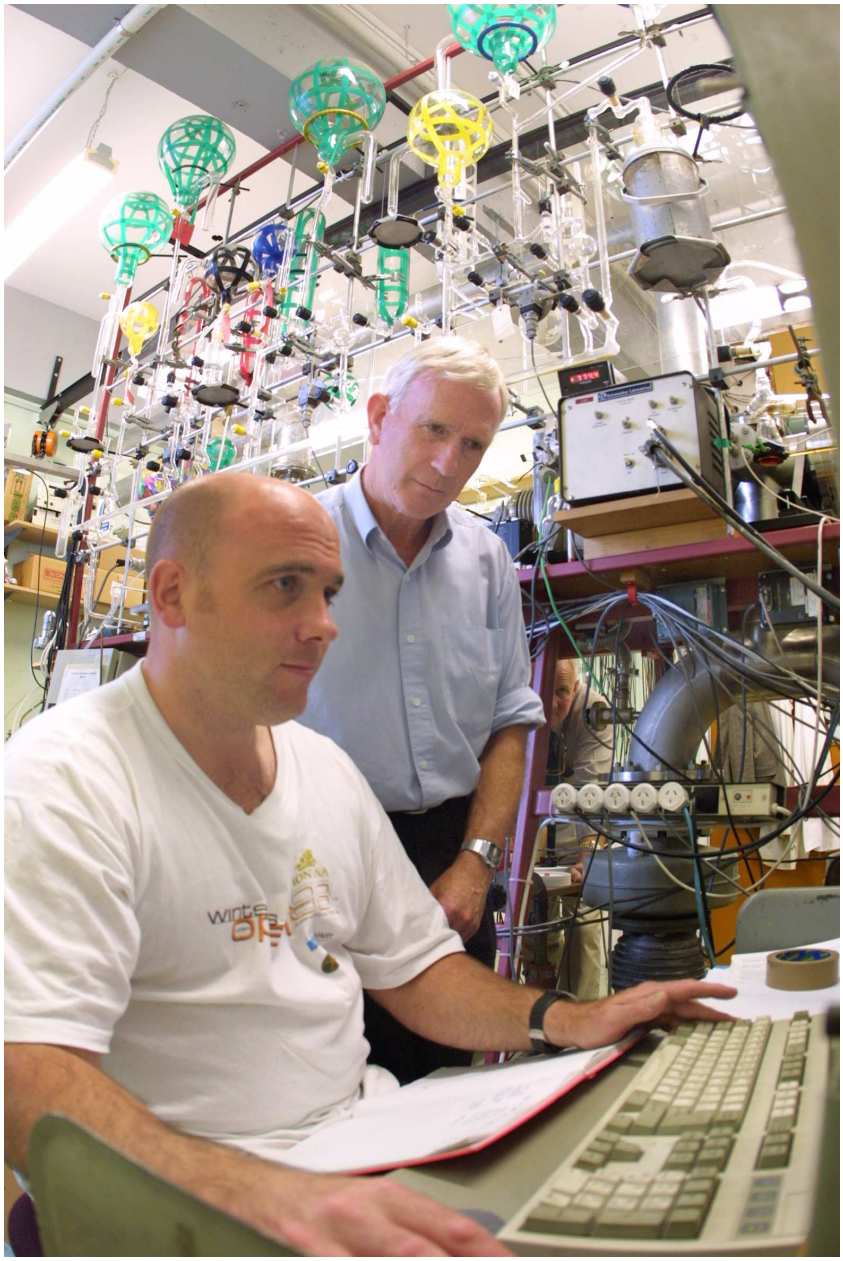
During 2003/04 there have been numerous publications in prestigious journals, 3 in *Science*, 2 in *Nature* and 1 in *Proceedings of the National Academy of Sciences*. Prizes and awards received by Marsden researchers include Member of the NZ Order of Merit, Fellow of the Royal Society of New Zealand, Easterfield Medal, and Montana Book Awards winner and nominee (Appendix I, Table 14).

Impact

Marsden researchers are funded to be at the cutting edge of knowledge globally, and this is where much of its impact is felt. In mathematics, for example, over a period of nearly ten years the Marsden Fund has supported the development of what is now recognised as a major new branch of theoretical computer science, parameterised complexity. This provides a much more efficient method of solving problems by computer and, in time, it will have impacts in many fields including economics and biology. Marsden researchers are at the international forefront of many other fields, including molecular evolution, ecology, psychology, and physics. A measure of this is the readiness with which Marsden researchers attract international funding, for example, NSF and Fulbright funding, and the Research in Peace prize (Appendix I, Table 14).

Marsden provides the ideas and the underpinning research for more applied research, such as that funded by NERF and Research for Industry. In some cases, benefits are sufficiently near-term to attract the interest of investors such as local entrepreneurs, local institutions, and international companies. An outstanding example is the flowing afterglow-selected ion flow tube (FA-SIFT) mass spectrometer which has been developed at Canterbury University to study interstellar chemistry. This has applications in medical diagnosis, oil exploration, and environmental monitoring, to name just three fields, and is now the business of a company which employs 27 people. There are other examples of research that lead to commercial opportunities, such as the provision of NMR instrumentation, funded by FRST, which arises in part from expertise developed under Marsden. Increasing opportunities in nanotechnology have also had their genesis in Marsden.

Figure 7. **Dr Paul Wilson (foreground) and Professor Murray McEwan, working with their research FA-SIFT instrument. The commercial version of the instrument is much more compact.**



Marsden also contributes to environmental, social, and cultural wellbeing. Current research on whale numbers addresses the discrepancy between catch records and genetic markers as a means of establishing former populations of these creatures, with overriding importance for conservation. Research on social capital has attracted the interest of regional councils, who wish to be socially inclusive, while Marsden researchers in the humanities have contributed enormously to New Zealand's cultural knowledge, with books in the last year on Captain James Cook, John Mulgan, and nineteenth century English rural workers.

ENHANCING GLOBAL CONNECTEDNESS

International Collaboration

The Marsden Fund brings about a high level of international collaboration. Marsden research is of global significance, and is funded to support overseas collaboration and the dissemination of results worldwide.

Critically important is that Marsden proposals are refereed by overseas specialists, thus successful applicants have the confidence that their proposed research is internationally competitive. A significant percentage of Marsden contracts (40% in the 2003/04 funding round) involve international collaboration at their inception, but many more develop international links during the course of the project (Table 1), due to the significance of the research and opportunities to present the work internationally. In the end, most projects develop international collaboration (66% in 2003/04). Data for the previous 4 years are similar.

Table 1. International collaboration and communication on Marsden grants.

International collaboration and communication	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004
International collaboration – successful proposals in the year's funding round with PIs and/or AIs from overseas	30%	34%	26%	38%	40%
International collaboration – current contracts with international collaboration (excepting proposals funded in the year's round)	73%	67%	67%	65%	66%
International Presentations – current contracts (excluding those awarded in the year's funding round) which were presented at international conferences	67%	63%	65%	72%	78%

Bibliometric studies support the case that Marsden promotes international collaboration. 48% of Marsden-funded publications have international co-authors, compared with 38% for other New Zealand papers.

The benefits of international collaboration are listed in Appendix I – "Enhancing Global Connectedness".

International Exchange

Increasingly, postgraduate students are being given opportunities to visit overseas laboratories and research institutes, and to present their work at overseas conferences. Similarly, New Zealand is also benefiting from extended visits by overseas students. This trend complements the exchange of senior researchers, which has been a traditional feature of Marsden, and the contribution of postdoctoral fellows, many of whom are recruited from overseas.

BUILDING HUMAN CAPACITY

In 1996, Dr Robert McLachlan, a beginning lecturer at Massey University, received his first Marsden grant, entitled "Unconventional methods and structures in numerical differential equations". This turned out to be the first grant anywhere in the world for a topic that was to become known as geometric integration. This is a field of mathematics which provides computational methods of solving equations that have been impossible to solve previously. It has a wide range of applications.
In 2002, Robert McLachlan was elected a fellow of the Royal Society of New Zealand and was awarded a personal chair in applied mathematics. In 2003, he presented his inaugural professorial address, won the New Zealand Association of Scientists' Research Medal (awarded annually to a scientist under 40), and started work on his second Marsden project, "Geometric Integration".

Quantity and Type of People Supported by Marsden

Table 2 shows the participation of various groups in Marsden projects. There is strong support for new researchers, as demonstrated by the large percentage of projects which support emerging researchers, postdoctoral fellows and postgraduate students. The percentage of principal investigators who are women is currently 26%, 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.

Table 2. Participation in Marsden grants.

Building human capacity	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004
Investigators – Number of separate individuals acting as principal and/or associate investigators on current contracts[6]	660	729	769	791	923
Emerging researchers – Percentage of PIs[7] on contracts awarded in the funding round who have received their highest degree within the last 10 years	26%	27%	38%	38%	43%
Postdoctoral fellows – Percentage of standard contracts in the year's funding round which involve postdoctoral fellows[8]	47%	44%	47%	47%	48%
Students – Percentage of contracts in the year's funding round which involve postgraduate students[9]	47%	70%	49%	57%	59%
Women – Percentage of female PIs on contracts awarded in the funding round	18%	18%	25%	22%	26%
Māori – Percentage of Māori PIs and AIs[10] on contracts awarded in the funding round	1.6%	0.9%	4.0%	1.3%	5.6%

Appendix I – "Building human capacity" has further information.

Recruitment and retention

Surveys, reported in previous PARs, have shown that Marsden funding has led to researchers being attracted to New Zealand. The surveys also show that Marsden projects have helped retention by, for example, training researchers so that they can attain independent research posts, giving people the opportunity to progress in their careers, and employing people who would otherwise have left research.

The Fast-Start Scheme for Emerging Researchers

The third year of the Fast-Start programme, which provides grants of $50,000 per annum for a maximum of 2 years, saw 28 applications funded. The total number of Fast-Starts supported since the scheme's inception in 2001 is 66.

Survey of 2001-2003 Fast-Start Recipients

Fast-Start researchers were surveyed to determine outcomes from the scheme, and their opinions on barriers faced by recipients and their priorities for the further development of the scheme. A full report of the survey is presented Appendix IV.

Results show that the Fast-Start scheme is achieving its aims of launching independent research and developing the careers of emerging researchers. The prestige of gaining a Marsden grant, and the explicit provision made for emerging researchers without long track records, were felt to be particularly important factors.

[6] **Current contracts** – those operating in the Government financial year indicated
[7] **PIs** – Principal Investigators –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
[8] **Postdoctoral fellows** – emerging researchers who have completed a Ph.D., usually within the last few years, and are employed on contract (often 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.
[9] **Postgraduate students** – researchers who are working on a Masters of Ph.D. thesis.
[10] **AIs** – Associate Investigators – researchers who play a lesser role than principal investigators and sometimes are involved with only limited aspects of the work.

> *"Receiving such a prestigious grant early in my career has given me the opportunity to demonstrate my ability to procure funding and undertake a research program independent of other established scientists."*
> *"There is a sudden recognition that what you are doing must be good if Marsden are willing to fund it."*

Some recipients raised issues with the small size and short duration of the grants, but there was also recognition that the recent increase in the size of the grants, from $50,000 per year to $70,000, will contribute to redressing these problems. Overall, when asked to prioritise between the award of more grants, longer grants, or larger grants, the most frequently chosen option was more grants (47%).

Overall, recipients were highly supportive of the scheme and felt that it fills a necessary niche in the New Zealand funding environment.

> *"It gave me a chance to initiate a project and begin to establish a research programme at the University. Without this I think I would probably have given up and gone back (overseas)!"*
> *"It's a great way to really start researching on your own, without the meddling of an advisor or boss and develop one's intellectual and financial independence. The existence of a pool of funding that is accessible only to only young, rather inexperienced researchers (rather than the 'big guns'), provides a more level playing field, and the confidence and experience gained from securing a small Fast-Start grant is helps significantly for subsequent grant writing!"*
> *"By ring fencing Fast-Start money for new researchers Marsden ensures that there is always a new cohort of researchers being fostered in New Zealand. Thus, there are people always feeding into the broader research landscape. This can only be a good thing in the long run for the country."*

FUTURE OF THE FUND

A strategic analysis of the Fund has been undertaken which focused on its position within the research, science and technology environment, its scope and its impact to determine whether changes are needed to maximise the Fund's benefit. The Marsden Fund makes a substantial contribution to the research environment in New Zealand as demonstrated in the previous section. The Fund is presently the subject of an output review by MoRST which should reinforce the value it delivers and place the investment made by the Government through this mechanism in perspective within the entire RS&T vote.

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.

Issues highlighted by the analysis are:

- the extent to which young and emerging researchers can be supported;
- the increased interest in the Fund and the consequent large number of high quality proposals not funded;
- the impact of increases in research costs on the Marsden Fund Council's 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.

Specific new opportunities identified are:

- increasing the number of Fast-Start awards; and
- opportunities for co-funding with overseas funding agencies.

SUPPORTING YOUNG AND EMERGING RESEARCHERS

Marsden Fast-Start awards are used to kick-start the careers of promising young researchers. The scheme has been piloted over the last three years and 66 individuals have been or are being trained. The grant is sufficient to allow the researchers two years of funding for their own personal activities, they are deliberately not large enough to provide for the hiring of other research staff, the intention is that the researcher carries out their research themselves.

Enabling young researchers this way helps them build practical research skills and enables them to choose to investigate their own questions. This initial support helps them build evidence of successful and novel research practise so that they can compete with the track records of older researchers who have spent more time at the coal-face.

This scheme is recognised as being able to provide a supply of excellent young researchers. There is a large potential pool of very talented researchers who could benefit from a 'kick-start' in their research career. In 2004, largely as a consequence of the introduction of the universities' Performance Based Research Fund (PBRF), the number of applications increased by 77%, but the Fund is only able to support 25 new awards. It did this by diverting funds which would normally be committed to Standard awards. Experience in previous years when up to 22% of the applicants could be funded with no compromise in the quality of the research or of the researchers supported, shows that in the future many suitable and excellent applicants will be turned away. These people represent a lost opportunity for New Zealand. We recommend an increase to the Fund to allow an additional 15 Fast-Start awards to be made each year.

COMPENSATING FOR THE INCREASED COST OF RESEARCH

Each year the cost of standard research proposals submitted to the Fund increases.

Part of the rise is due to projects becoming larger, i.e. more researcher time has been requested. Part of the increase is because intrinsic costs such as salaries, postgraduate student stipends and overheads have risen. In 2004 the universities moved to introduce new indirect cost rates. For all new contracts awarded in 2003 the average proportion of funds going to overheads was 31%. For the proposals chosen for funding in 2004, the average proportion requested for overheads was 35%. If this increase is reflected in the contracts yet to be negotiated, $1.33 million (or 4% of the fund) will have been diverted from paying for salaries or direct costs into overheads compared with 2003.

This increase and its impact on the Fund were signaled in the 2003 Progress and Achievements Report. Knowing that cost increases of this magnitude were imminent, and to ensure that recipients could undertake reasonably sized projects, the Marsden Fund Council decided in 2003 to raise the fixed amount awarded on Fast-Start grants from $50,000 to $70,000 per year from 2004.

The Fund has been increased by $1.5 million for 2004/05, but this was pre-committed last year in order to more rapidly reduce the fund balance held and so was not available to apply to projects chosen from the 2004 funding round.

FUNDING MORE HIGH QUALITY RESEARCH/INCREASING THE KNOWLEDGE BASE

The objectives of the Marsden Fund are to

- enhance the underpinning knowledge-base in New Zealand, and contribute to the global advancement of knowledge;
- broaden and deepen the research skill-base in New Zealand; and
- enhance the quality of the research environment in New Zealand by creating increased opportunity to undertake excellent investigator-initiated research.

The Marsden Fund Council believes that there is substantial scope for increasing the Fund's delivery of these objectives by increasing the number of awards made. Evidence from the international peer review of the funding proposals received indicates that it is possible to fund at least one third more proposals while maintaining the high standard of excellence required for Marsden research. Similarly evidence from the bibliometric study of completed Marsden projects shows the quantity, quality and impact of the research[11].

[11] Knox, A.L. (2004) "The Impact of Marsden-funded Research: a bibliometric assessment of Marsden-funded publications, 1997-2001". Available: http://www.rsnz.org/funding/evaluation/impact.php

Figure 8. **Distribution of referee grades for 2004 full proposals**

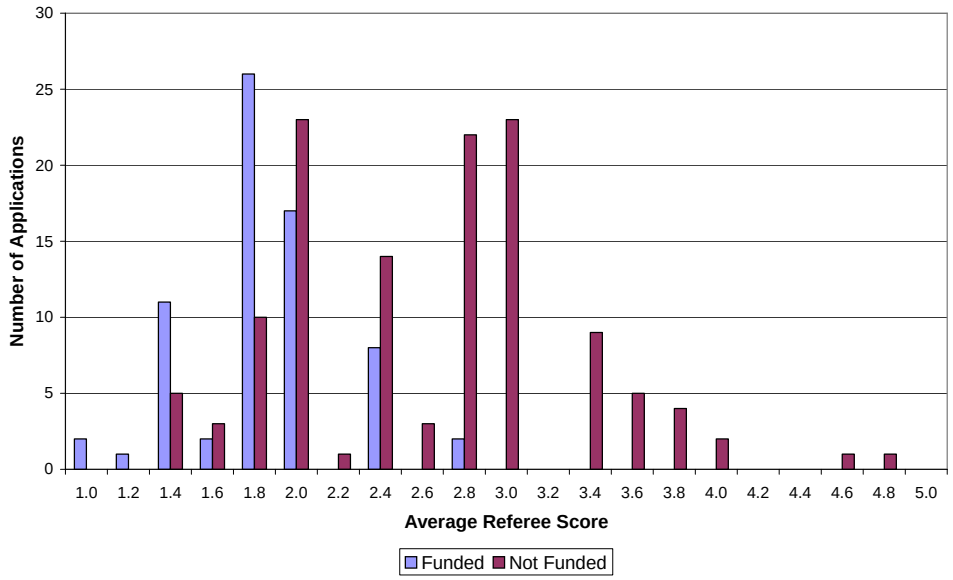


Figure 8 shows the distribution of referee scores for both funded and unfunded proposals to the 2004 funding round. A score of 1.0 equates to "Outstanding – among the top 5% of proposals worldwide" and a score of 2.0 indicates "Excellent – among the top 10% of proposals worldwide". In the 2004 funding round there were 23 proposals that referees scored at 2.0 or better that were not funded.

The Marsden Fund Council is conscious of the need to balance the prestige of receiving an award against expanding access to funding. However, an increase of this magnitude would only take the success rate close to the historical level of 10% of applications received.

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.

As a consequence of the special release of funds in 2003 and the introduction of the Performance Based Research Fund in the tertiary education sector there has been a marked increase in the number of research proposals to the Fund. This increase, together with the lower number of proposals able to be funded, will have a compounded effect of substantially reducing the success rate to the Fund. In 2002/03 the success rate was 10.2%. In 2003/04 with the special release of funds the success rate was 14.2%. For the latest funding round, the results of which will be announced in September 2004, the success rate will fall to 7.3%. By comparison, applications for Discovery Grants, a similar but perhaps less prestigious scheme offered by the Australian Research Council, have a 25% success rate.

If interest in the Fund remains strong with a similar number of proposals being received as in 2004, 972 applications, then the Fund needs to have $76 million to distribute each year to maintain optimal quality and success level. The Council considers this level of funding a long-term goal, but strongly recommends a rapid move to a fund size of at least $50 million.

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 in early 2005 associated with the 10th anniversary of the establishment of the Fund.

INCREASING COLLABORATIVE LINKS WITH THE BEST OVERSEAS RESEARCH

An already strong feature of the Marsden Fund is the contribution it makes to global connectedness. Table 1 (on page 28) 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 to a similar timetable as 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. Discussions will continue with the hope of introducing linked funding in the future.

SUPPORT AND ADMINISTRATION ACTIVITIES

The establishment of the Marsden Fund Council 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 Memorandum of Understanding 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 Marsden Fund Council.

In the five years since 2000/01, the Fund has increased in size by 33% and it is scheduled to increase by a further 3% next year. Changes of this magnitude lead directly to increased resource requirements for handling and evaluating the applications, and for administering the projects that are selected for funding (negotiating contracts and the monitoring and evaluation activities). The resources required to maintain the high standard of application evaluation, research contract monitoring and fund evaluation will not be able to be provided within the current administration funds provided.

The past year has seen the combination of the largest number ever of new contracts being awarded (in the 2003 funding round) and the largest number ever of new proposals being assessed (2004 funding round).

The current fee provided to administer the Fund does not provide adequate resources to undertake these activities. Handling more proposals not only adds to the administrative load, but it also requires more panellists to be appointed, and in 2005 it is anticipated that an entirely new panel will be needed to handle the big increase in proposals from the social sciences. Considerably more time was required this year to find the additional referees needed to peer review the proposals. This reduced the amount of time available for monitoring and evaluating the progress of the active contracts. Costs have also risen and will rise further

because of inflation. Although there were small increases in the fee made in the 2002/03 and 2003/04 years, these have been absorbed by the new honoraria levels set for the Marsden Fund Council in 2002 and the increase in the number of panellists needed. With increased costs for the 2004/05 year, and without a concomitant increase in administration fees, it has been necessary to reduce Research Assessor time at the Royal Society by 0.4 FTE resulting in the loss of a staff member.

Table 3 summarises the state of the Marsden Fund in recent years together with the indicative increases signalled by the Minister. The table also shows the fee paid to the Royal Society to administer the Fund.

Table 3. Growth of the Marsden Fund.

	2000/01	**2001/02**	**2002/03**	**2003/04**	**2004/05**	**2005/06**
						estimated
Fund Size	$25.8 M	$27.8 M	$30.8 M	$32.8 M	$34.3 M	$35.3 M
Applications						
Preliminary	756	884	801	741	972	
Full	136	179	165	171	194	
New Contracts awarded	73	82	86	105	69	
Active Contracts	336	356	365	395	400 (estimate)	

The nature of the Marsden Fund, with emphasis on peer review, progress monitoring and evaluation, means that an ongoing increase in the management fee in line with future increases to the Fund is essential. The Marsden Fund Council is also seeking an increase to the fee to raise the standard of policy analysis and advice provided to it. Therefore the Society recommends that fees for the MFC and administering the Fund be linked to the fund size as a reasonable proxy for the amount of work required to run an assessment round, contract and monitor progress, evaluate outcomes and provide support to the Marsden Fund Council. For the reasons given above, this needs to be at a significantly higher rate than at present.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

There are four elements to the future investment recommendations. These are:

- increasing the Fund to support an additional 15 Fast-Start awards each year;
- increasing the Fund to restore its purchasing power which has been eroded by increased research costs, especially from the university sector;
- enlarging the Fund to increase the quantity of high quality research undertaken and the consequent expansion of the contribution to the knowledge base in New Zealand; and
- increasing the fee 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

The recommended increases would, in addition to the $1 million increase for 2005/06 already announced, raise the Fund from its current level of $34.3 million to nearly $50 million over a three year period. With funding at this level it would be possible to continue increasing the number of young and emerging researchers supported by the Marsden Fund thereby contributing to the pool of skilled and talented New Zealanders. It would also be possible to increase the overall effectiveness of this form of investment in New Zealand's future. The Fund supports New Zealand's best research ideas and our best people. It performs extraordinarily well in terms of the productivity of the researchers and the quality of the research undertaken. The increase would restore the relatively modest success rate for applicants to the Fund from the current rate of 7% to the historical levels of 10%. These rates are well below that of the Australian Research Council who target 25% for their Discovery Fund.

The importance of increasing the funding for the fund administration activities has been described in this Marsden Fund chapter. Essentially, a $34 million fund is delivered by five staff with some administrative support – several times more efficient than similar-sized funds in New Zealand. There has only been one small increase in the delivery fee despite increases to the Fund every year for five years. The Marsden Council and the Royal Society recommend an increase of the administrative fee. This higher level would recognise the additional administrative load that has been caused by the introduction of the Fast-Start awards and the consequent increase in the number of applications to be handled and contracts to be managed. These smaller awards are about a third the dollar value of Standard awards, but each has the same administrative, monitoring and evaluation requirements as a Standard award.

The increase in administration funding, would be targeted at:

- providing for the cost of an additional assessment panel;
- providing more resources for monitoring and assessment, especially staff who have a background in social sciences or the humanities;
- undertaking more promotion activities to encourage participation in the Fund and to demonstrate the value obtained from Marsden funded projects; and
- undertaking policy analysis to provide quality advice to the Council on options for fund development.

SUPPORTING PROMISING INDIVIDUALS

JAMES COOK RESEARCH FELLOWSHIPS 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 scheme was established in 1969, discontinued in 1991, but then re-instated under Royal Society administration in 1996.

The Fellowships are one way in which the Government supports the development of people with knowledge, skills and ideas. They allow our best researchers to concentrate on their chosen research for two years and enable them to achieve over and above what they could otherwise do with the constraints of administrative and teaching loads. These two years of dedicated research allow them to focus a lifetime of study and scholarship on issues that advance New Zealand's role in knowledge creation. For many, the two years have been transformative and have led to impressive achievements (see highlights below).

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.

Currently, the fund provides for two years of dedicated research for five fellows, with stipulation in the Terms of Reference that there be at least one social science Fellowship in operation at any time. The Fellowships are offered in rotation among the disciplines, two or three a year. Occasional third year extensions are granted.

Applications in the areas of Biological Sciences, Health Sciences and Social Sciences were called for in early 2004 for a start in March 2005.

During 2003/2004 there were nine active James Cook Research Fellowships and these are listed in Appendix V.

Three Fellows who finished their two-year tenures during 2004 asked about one-year extensions to their Fellowships but existing funding was insufficient for consideration of any extensions.

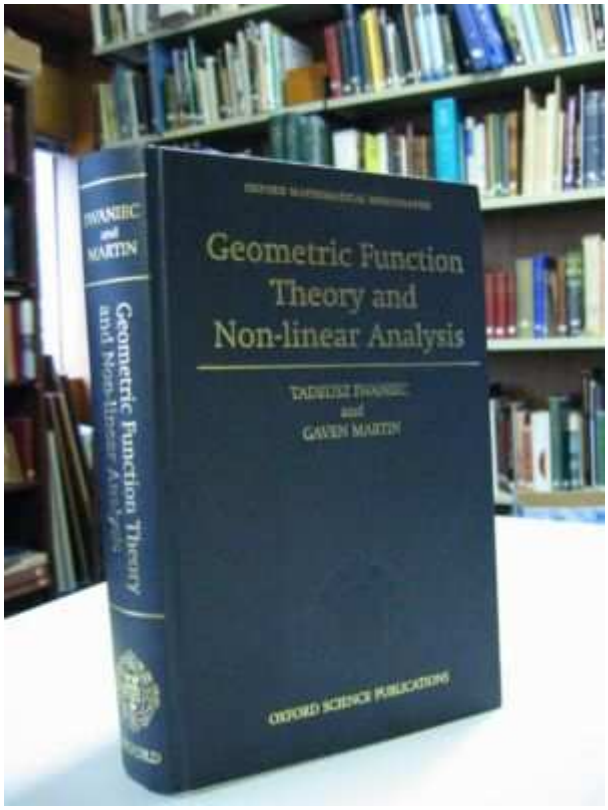
A recent increase in the annual stipend has enabled Fellows to spend some time overseas and this has been very valuable. However, to accommodate the increased stipend and without increased funding there has been a reduction in the overall number of Fellowships awarded, from 6 to 5. This is concerning as it means that researchers in some subjects will have to wait 3 years for an opportunity to apply. In addition, health researchers may not be applying in equal numbers to other disciplines, because the stipend, (less GST), with only a small grant for expenses and no overheads is insufficient to maintain their clinical or basic health research.

HIGHLIGHTS

Four Fellows finished their Fellowships within the 2003/2004 period and all produced excellent research during their tenure. The results of two are highlighted below.

Professor Gaven Martin FRSNZ, University of Auckland, had a Fellowship from 1 May 2001 to 1 May 2004. He said in his final report: "I believe the fellowship has been enormously successful and among the most productive three years I have ever had."

Figure 9. Professor Gaven Martin's book – "Geometric Function Theory and Nonlinear Analysis"



During his Fellowship, Professor Martin made major advances in his very ambitious research programme. He has settled a number of outstanding mathematical problems that were previously thought unapproachable. For instance, he found the most complete solution yet of the Hilbert-Smith conjecture (from 1900), the solution to the Lichnerowicz problem on conformal dynamical systems in low dimensions (1965) and the solution to Siegel's problem determining minimal co-volume hyperbolic lattices in dimension 3 (1945).

Further advances were made in his study of the partial differential equations associated with theories of linear elasticity, modelling deformations, and conformal geometry. His work has generated an entirely new field of research that is now a major focus for other mathematicians, and it has significant implications for materials science.

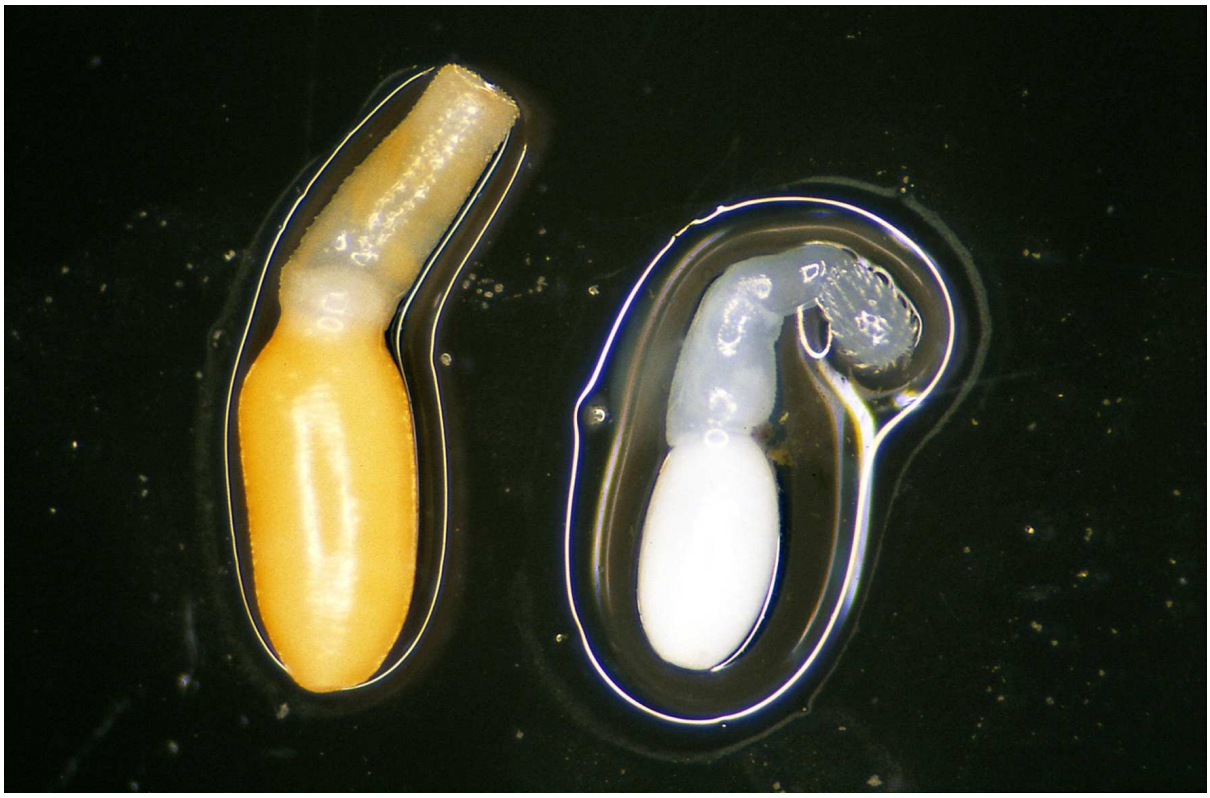
This work has resulted in the publication of 16 research papers, largely in top international journals of mathematical research, 1 book, and a further 5 papers have been accepted for publication, and 2 book manuscripts are in preparation. His book entitled 'Geometric Function Theory and Nonlinear Analysis' has been described in reviews as "set to become the standard reference in the area" and was chosen as one of the top 100 pure and applied Mathematics publications for the year internationally.

Professor Martin's work has been presented worldwide. He was awarded a Miller Fellowship to visit the University of California at Berkeley. The Miller Foundation is one of the top few international foundations

making grants for researchers in all the fundamental sciences, and Professor Martin is only the second New Zealander to achieve this recognition. Following that visit he received an invitation to visit the Institute for Advanced Study in Princeton, and was awarded a prestigious "Research in Peace" fellowship at Institute Mittag-Leffler in Stockholm.

Professor Robert Poulin FRSNZ, University of Otago, finished his highly productive two-year Fellowship in June 2004. During his Fellowship he published 29 papers and one book. Serendipitous findings created new branches of endeavour, but funds were insufficient for Professor Poulin to be granted a third year extension.

Figure 10. Larval acanthocephalan worms (Profilicollis spp.) parasitic in New Zealand shore crabs and responsible for significant crab mortality by facilitating bird predation on crabs (magnification x30). Picture by Robert Poulin



Professor Poulin's main objective was to analyse large-scale patterns of parasite biodiversity in order to better understand the ecological and evolutionary forces that determine the distribution of parasitic diseases among animal species and across geographical areas. For instance: Why do some animal species host large numbers of parasitic species, when very similar species are hosts to only a few? Does the biodiversity of parasites peak in the tropics, as it does for many other groups of organisms? Why have certain groups of parasites diversified more quickly than other groups? Professor Poulin tackled these questions by bringing together theoretical perspectives from ecology, biogeography, evolutionary biology and epidemiology, and by using large data sets that he and his colleagues compiled for this purpose.

He also investigated aspects of parasite transmission, using native New Zealand species as models. For instance, most parasitic worms use two or three host species to complete their life cycles, but a few native parasitic worms are able to abbreviate the cycle by skipping one host, reaching adulthood more quickly. Professor Poulin performed laboratory experiments to assess the role of external factors in triggering the switch from normal to accelerated growth. He also examined factors that interfere with the transmission of parasites, such as the presence of organisms that feed on the dispersal stages of parasites. Professor Poulin and his collaborators quantified the impact of such interfering organisms on parasite transmission in intertidal ecosystems. His work has provided new insights into how parasitic diseases are transmitted, and allows

better predictions of how or whether newly-identified parasites will adapt to live in new host species. This helps to assess the vulnerability of certain species to parasitic infection, and has important implications for biosecurity, conservation, ecology and assessment of biodiversity.

EVALUATION

SUBJECT DISTRIBUTION

Since the scheme was reinstated in 1996, 24 Fellowships have been awarded and have been fairly evenly distributed across subjects. In total, we have had:

- 4 in biological sciences;
- 3 in engineering;
- 3 in health sciences;
- 5 in physical sciences;
- 4 in research of relevance to New Zealand; and
- 4 in social sciences.

However, the number that can be active at any one time has now dropped from 6 to 5 due to a necessary increase in the stipend, but no compensatory increase in the size of the fund. We are currently required to ensure that one fellowship is active in the Social Sciences at all times. We anticipate that, in combination with the reduced number of Fellowships awarded, this will put pressure on other disciplines, and some researchers will be disadvantaged by having to wait three years between funding rounds for their field.

OUTCOMES FROM JAMES COOK FELLOWSHIPS

Publications

Four James Cook Research Fellowships were completed in the 2003/2004 year. They were, collectively among the most productive since 1996, resulting in the publication of:

- 50 papers;
- 2 books; and
- a further 5 papers in press and 2 book manuscripts in preparation.

This represents an excellent return on the total investment in these four fellowships.

Monitoring and Evaluation Visits

In a new development for 2003/04, we have implemented monitoring visits for James Cook Fellows. These visits allow the Manager of the scheme to monitor outcomes better, and to identify and tackle any problems arising during individual Fellowships. In this financial year, 6 Fellows were visited, 4 of whom were nearing the end of their tenures, and 2 of whom were within their first year.

Collaborations

Collectively, more than 21 international collaborations were set up with researchers in France, Germany, Switzerland, Sweden, Finland, Brazil, Chile, Australia and the United States of America.

At least 4 collaborations within New Zealand were also set up by James Cook Fellows. In one case it was stated that the specialised nature of the research did not lend itself to collaborations within New Zealand.

Training

Most of the Fellows interacted with and trained young researchers as part of their James Cook research.

Through their work, young researchers have been up-skilled in the areas of statistical and mathematical analyses, computational analyses, chemical and physical analytical methods, and cutting-edge methods of

dating archaeological finds. This has, in at least one instance, made it easier for the students to gain subsequent employment.

Two Fellows also stated that their interaction with students from overseas had been very beneficial for the students, and in one case the Fellow was able to attract some talented students from Germany to work in New Zealand.

Public Outreach

The work of two of the Fellows has had a very high profile outside of as well as within the research community.

One is using the methods of evolutionary biology to examine linguistic data and the relationships between different languages. High profile articles have been published in Nature and Time magazine as well as many other international newspapers, and the Fellow has participated in 3 National Radio interviews and 5 ABC radio interviews.

The other has found evidence of remarkable Bronze Age 'super burials' that have transformed our understanding of prehistoric Southeast Asia, and the Fellow has recently participated in seven television documentaries made by the Discovery Channel, National Geographic, Natural History New Zealand, ITV Bristol, The Public Broadcasting Service in America, and Readers Digest.

THE EFFECT OF JAMES COOK FELLOWSHIPS ON ON-GOING PRODUCTIVITY

In a follow-up study of James Cook recipients three to five years since finishing their Fellowships, it was obvious that some attribute great productivity, post-James Cook, to the Fellowship. Two examples are below.

During his two-year Fellowship Associate Professor Michael Eccles, University of Otago. made advances in kidney development and disease, and diseases of overgrowth of cells, namely cancer and polycystic kidney disease. Most of the work was carried out in collaboration with McGill or Harvard University researchers. Since finishing his Fellowship in April 2002, Professor Eccles has written two book chapters, published 8 more papers and has 3 patents under review. He has continued to work in the Developmental Genetics Laboratory at the University of Otago, that he set up during his James Cook tenure and this has given him greater independence in his research. Setting up the laboratory enabled him to attract postdoctoral research fellows who have greatly assisted in furthering the research started during his Fellowship.

Associate Professor Geoffrey Krissansen finished his Fellowship at the beginning of 2000. His research focussed on understanding multiple sclerosis in order to find new treatment strategies; devising a potent new way of treating cancer; gaining more understanding on cardiovascular disease; identifying new potent treatments for inflammatory disease; and cloning and characterising five human genes encoding cell adhesion molecules. When followed-up, he identified 13 new published papers and 11 new patents attributable to his James Cook research. Associate Professor Krissansen's continuing research on multiple sclerosis has recently (July 2004) received substantial exposure in public media, and he attributed the award of his Fellowship as giving the project a significant boost.

THIRD YEAR EXTENSIONS—ARE THEY VALUABLE?

Five Fellows have received third-year extensions to their James Cook Fellowships since the Fellowship was reinstated in 1995/96. Two are highlighted below.

Professor Gaven Martin, University of Auckland, researched two fundamental areas of mathematics. The third-year extension allowed him to finish three research monographs, publish five papers and have another five accepted for publication. In the first two years, his research generated new serendipitous findings, and the third year allowed him to examine these new avenues and develop them into new research areas.

Early in his James Cook Fellowship, Professor Jeff Tallon, Industrial Research Ltd and Victoria University of Wellington, discovered an entirely new class of hybrid materials with unprecedented properties for high temperature superconductivity. He used his third year to carry out critical and systematic investigations while he still had a lead on competitors. The third year also allowed him time to write a review of this work which has since made a strong impact in the international community and is highly cited.

This year all three Fellows finishing their tenure after two years enquired about a third year extension. Unfortunately there was no money available for this.

INTERNATIONAL COMPARISONS

Several Fellows have mentioned that the tenure of the Fellowships is too short especially when compared to Fellowships of similar prestige overseas. By the time a Fellow gets their research up and running, six or more months of the two-year tenure may have elapsed and this only allows 18 months to make significant advances in the proposed research. The international benchmark for Fellowships of this type appears to be three to five years, as seen in the various UK research council 'senior' or 'professorial' fellowships. Similar German fellowships are usually for three to five years. Clinical fellowships both in New Zealand and the UK are four to five years and longer. The salaries of most of these fellowships are in line with senior professorial or clinical salaries in the respective countries, with additional support available for travel and/or direct costs.

An improvement to the New Zealand scheme could be achieved simply by enabling third-year extensions for all applicants, which would bring it closer to international benchmarks for such fellowships.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

WHY SUPPORT THE JAMES COOK FELLOWSHIP SCHEME?

The James Cook Research Fellowships demonstrate that giving our best researchers the freedom and time to use their skills and talents has a massive return on Government investment in people.

- The unusually high output of original research papers and patents provides a wealth of material that contributes significantly to New Zealand's knowledge base, and exposes the international community to New Zealand's strongest areas of research.
- The international collaborations and extended networks provide opportunities for post-docs and researchers to come to New Zealand for training, and vice versa for young researchers seeking employment overseas.
- Collaborations with, and the training of, post-docs by Fellows benefits the future skills and knowledge of researchers.
- The public recognition of research is increased, with international and local media interest in Fellows.

An institution also receives a great deal of prestige when a staff member is recognised by the award of a Fellowship. It is likely that the Performance Based Research Fund in Universities is increasing the number of applicants for James Cook Fellowships, as the most excellent, and productive researchers in universities will be encouraged to apply for such fellowships. For example, in 2004, the numbers of applicants for 2005 Fellowships are up on last year by an average of at least a third per subject area. Numbers of applicants are listed below.

BUDGET

The number of Fellowships offered every two years has now been reduced from six to five, and extensions are often declined because of a lack of funds. The scheme has not received an increase in funding since it was reinstated nine years ago, and in the meantime Fellowship stipends have risen to account for inflation of 24%.

The reduction of the number of Fellowships offered means that the scheme does not work properly -some researchers must now wait up to three years for a chance to apply for a Fellowship in their field. Two-year tenures are considered too short by Fellows and international comparisons show that tenures of up to five years are considered the normal benchmark.

The optimal number of fellowships, considering the current subject areas, should be six. Then all of the subjects can all be offered every two years. It is important to maintain the prestige of these fellowships, while enabling equality of access among researchers.

We recommend an increase of funding to the scheme to allow reinstatement of a sixth Fellowship, and a negotiable third-year extension for all. Analysis of the achievements of Fellows who had third year extensions as compared to their first 2 years shows that such extensions allow researchers to build on their findings, and in many cases to follow new, serendipitous avenues of research that have emerged from their first two years of work.

Stipends are not full cost funded. This means that some fellows are subsidised by their departments. If the Government funding was doubled to enable overheads then such cross-subsidisation would not be required. This would allow equality of access to the fellowships, rather than applicants being limited to people who work in departments with particularly healthy cash-flows. The full cost funding also makes the fellowship line up with other research funding streams in New Zealand.

SUGGESTED MODIFICATION TO THE TERMS OF REFERENCE

When the Hodge Fellowships in Social Science were rolled into the James Cook Research Fellowships, the Terms of Reference stipulated that at any one time, there must be a Fellowship operating in the Social Sciences. Is it appropriate today to enforce this stipulation? In recent years applications/demand for

Fellowships in all six disciplines offered compare similarly with those in the Social Sciences. Information for 2001–2003 applications is listed below.

2001 applications

- Physical Sciences – 8 applicants
- Research of Relevance to the Peoples of NZ and/or the South-West Pacific – 13 applicants
- Biological Sciences – 8 applicants

2002 applications

- Biological Sciences – 5 applicants
- Engineering – 4 applicants
- Health Sciences – 2 applicants
- Social Sciences – 7 applicants

2003 applications

- Physical Sciences – 9 applicants
- Research of Relevance to the Peoples of NZ and/or the South-West Pacific – 7 applicants

2004 applications

- Biological Sciences – 14 (3 of which are to be assessed also by Health Panel)
- Health – 10 (3 of which are to be assessed also by Biological Sciences Panel)
- Social sciences – 9

The Terms of Reference state that the normal term of the Fellowship will be two years extendable to three years depending on the outcome of a review after the initial two-year period. We propose that these extensions be possible for all qualifying applicants, rather than these extensions being limited to one person per year, or as funds allow. If this is not going to be the case, then the terms may need to be changed so they are not misleading. We recommend that a review of the Terms of Reference be conducted, with respect to the disciplines offered, particularly the Social Sciences field, and the description of the tenure, by RSNZ Academy Council early in 2005.

SCIENCE, MATHEMATICS AND TECHNOLOGY TEACHER FELLOWSHIPS
OVERVIEW

The New Zealand Science Mathematics and Technology (NZSMT) Teacher Fellowships offer teachers the opportunity to improve their teaching through experience in technological or scientific practise. During their fellowship, teachers are able to immerse themselves fully in the discovery of knowledge, or the transformation of it into useful products or systems, and become more skilled in the communication of science and technology. The fellowships are aimed at primary and secondary teachers of sciences, mathematics, social sciences and technology. Evidence shows that following fellowships, teachers return to the classroom and their students rejuvenated and inspired[12][13]. They pass on that inspiration and enthusiasm for S&T to their students.

> *"My daily pleasure was to speak with and learn from the staff of 'my' university department. I do not think one can be an effective teacher without sharing the joy of learning."*
>
> Peter Arthur James Cook High School

The NZSMT Teacher Fellowships scheme is a part of the Supporting Promising Individuals output class. It contributes to supporting human resources in research, science, and technology and contributes to the development of people with knowledge, skills and ideas. This output class contributes primarily to the Knowledge Goal, demonstrated by the contribution made by the Teacher Fellowships in terms of professional development of teachers, contribution to new knowledge and innovative practise, and awareness of S&T opportunities for teachers and school pupils.

The programme has now been operating for 10 years and is a recognised and valued part of the school education sector, particularly in S&T. It has been valuable for allowing teachers who graduated in the seventies and eighties to update in areas which have undergone tremendous change (such as genetics) as well as enabling worthy teachers to refresh and reflect.

We receive many comments from Principals who attest to the benefits of the scheme to the individual teacher as well as to the school. They particularly comment on the renewed enthusiasm of the teacher, their increased knowledge and skills, their contribution to students and colleagues, and the widening of their horizons through being removed from the school environment and exposed to the practise of research and technology.

Scope & Scale:

Fully registered teachers currently teaching in a New Zealand school are eligible to apply for a NZSMT Teacher Fellowship.

Teacher Fellowship activities range from teachers becoming members of research teams such as at CRIs, tertiary institutions or Government agencies such as DoC, to becoming involved fully in technological practise in industries, carrying out their own research project. Some take the opportunity to spend time with a number of different enterprises to learn about the science and technology underpinning their activities.

In the past 10 years, 345 teachers were offered a NZSMT Fellowship. The number of Teacher Fellowships awarded has increased since 1994:

Table 4. Growth of the Teacher Fellowship scheme

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Number	17	19	19	15	16	18	36	40	48	58	59

Currently there are approximately 50,000 school teachers in New Zealand. It would be expected that a significant proportion of these teach science, social science, mathematics, and technology, although the exact

[12] Jordan, S. and Galt, N. 1999, "Science and Technology Teacher Fellow Evaluation", University of Canterbury
[13] Spratt, P. and Knox, A. 2003, "Enhancing understanding through practise", Proceedings 3rd World Conference on Science and Technology Education

number of these teachers is not known. The Teacher Fellowships, therefore, could potentially contribute to the professional development, rejuvenation and increasing S&T skills of a vastly greater number of teachers. In addition, the impacts of the fellowships are likely to extend beyond each teacher, to their pupils and to other S&T teachers with whom they interact.

Funding for the NZSMT Teacher Fellowships is provided to the RSNZ from the Ministry of Research Science and Technology and Ministry for Economic Development. Given the number of Teacher Fellowships in the environmental science/environmental education area, it would be entirely appropriate now for a contribution to be made from the Ministry for the Environment.

We are currently working to improve equality of access to the fellowships as well as increasing host numbers and improving relationships. This follows the recent increase in the numbers of fellowships available, and such ground-work is necessary in advance of further expansion of the scheme. Since the quantity of the scheme has been recently increased, we are continuing to work hard on improving the quality of the structure - particularly developing a good host network to support future expansions in Teacher Fellowship numbers.

HIGHLIGHTS

Paul Lowe of Morrinsville College spent his Teacher Fellowship year at Tatua Cooperative Dairy Company researching factors influencing the levels of lactoferrin in milk. Lactoferrin is a valuable protein found in milk and has desirable human health benefits; it currently retails at about $1,000 per kilogram. Paul's unique position in the local community as a teacher of long standing enabled him to collect data that has provided key information on these factors. Tatua Co-op now have clear directions in which to pursue this biotechnology research, and Paul has a very special set of experiences to share with his students and colleagues.

Figure 11. **Paul King, Southland Girls' High School and hosted by NIWA, launching an ozone sonde balloon at Lauder, Central Otago in his investigation into UV radiation over New Zealand**

Judith Sigglekow from Diocesan School for Girls, Auckland, was hosted by Hubbards Cereals where she was involved in technological practise ranging from the food technology of breakfast cereal production to marketing. Judith has this year returned to a 0.5 position with her school and 0.5 with Hubbard's so her students now reap all the benefits of a practicing technologist as a teacher.

Procedural highlights

Many activities were undertaken this year to increase the participation in the scheme of less-well represented groups:

- Teacher Fellows from these minorities required to promote the scheme to their groups;
- pamphlets in Te Reo and English sent to the Māori teachers' conference in Taupo;
- promotions in Education Gazette and conferences;
- talks by current Teacher Fellows in schools;
- web page production to give project /host ideas for possible applicants;
- worked with hosts to get more support and projects onto website; hosts promote website through their own sites;
- worked with new hosts to expand the reach of the scheme;
- hosts actively recruited from local schools by sending fliers and advertising for potential teacher fellows; and
- encouraged links between professional societies and local teacher groups

EVALUATION

Professional Development Outcomes

Most Teacher Fellows report that their project had a positive effect on their teaching. The most frequent comment is that it has allowed them to gain a wider perspective on research and technological practise, and on the careers and vocations available in these areas. The ability to call on their experiences to complement their teaching increases relevance and enlivens the topic being taught to their students. It also gives increased confidence and credibility to the teacher in the eyes of their students and the school community.

> *"I am finding that in many teaching situations I can call on the experiences of last year to illustrate or reinforce a point. This is also happening when discussing issues or teaching content with my colleagues. In particular the knowledge gained in web design is having an impact on the development of computing within the school."*
>
> Allister Gilbert, Whangarei Boys' High School

> *"I am finding the teaching of statistics to be extremely easy this year - I feel totally confident in every aspect of the course. I had a great chance to prepare for this when working on the CAST (Computer Assisted Statistical Teaching) program."*
>
> Gwenda Hill, Taieri College

Enhancement of understanding

Last year's Teacher Fellows were surveyed regarding:

- their understanding of S&T subjects;
- their knowledge of S&T applications; and
- their sharing of knowledge with colleagues, students and others in the general community.

The outcomes of this survey showed that some teachers are involved in running in-service courses in which they have greater enthusiasm, knowledge and confidence due to their fellowships. The teachers attending such courses are reported as giving positive feedback to the former Teacher Fellows, regarding the in-service training. This sort of 'outreach' enables more widespread benefits of the NZSMT Teacher Fellowships. It is a very efficient way to update the skills of S&T teachers throughout New Zealand. In addition, updating the knowledge and skills of teachers enables pupils to imagine a real future in S&T careers.

> *"I ran an in-service course for Biology teachers in Southland and Otago. I had really good feed-back - including one person who was dreading a day of statistics, but found it really interesting. I'm sure the fact that I had time to put together real-life examples contributed to this. Also I had developed enough knowledge of statistics and had talked enough with scientists at AgResearch to be quite confident doing this."*
>
> Gwenda Hill, Taieri College

> *"I learnt that my knowledge of winemaking was very sketchy so my scientific knowledge has expanded. Doing some real science also reinforced the scientific method that we teach kids as being the right way, … also that the industry is in need of skilled people across the whole process of winemaking and I can encourage and show students what these (processes) are. I have taken 2 classes out there this year."*
>
> Les Le Bas, Nayland College

Alignment with Government policy on the knowledge economy

Several fellowships were aligned with priority areas of the Government's Growth and Innovation Framework. There has been a particular increase in information and communication technologies (ICT). In 2004 (compared with 2003), we have 5 (7) Teacher Fellowships in Biotechnology area; 3 (2) in electronics; 6 (2) in ICT; and 1 (1) in design. These figures will vary each year.

> *"I have enjoyed new learning experiences and the development of skills which will be useful back at school (and) working with teaching professionals in a new field and making new friends."*
> *"I feel a new person, something which no holiday break has achieved."*
>
> Lynne Newell, Opoho School

Tracking teachers post-Fellowship

In total, 90.4% of Fellows returned to teaching or education-associated agencies, 5.3% retired or took leave, 1.7% moved to tertiary teaching and 4.4% moved to industry or a Government agency. Four teachers gained promotion either during their Fellowship or upon return to school; one relinquished management units on her return. A special situation developed with one teacher who now holds a 0.5 teaching position with her school and a 0.5 position as food technologist with her host. This will be of immense benefit to her students as her teaching will be informed by current practise.

Table 5. After a Teaching Fellowship

Post fellowship directions in 2003	FTEs (total = 57)
Returned to teaching	48.5
Seconded to College of Education as an Adviser	1
NZ Council for Educational Research	1
New position as a resource teacher of literacy	1
Maternity leave	1
Retired	2
To tertiary	1
To industry	0.5
Dept of Conservation	1

Promotion of the Scheme to Eligible Teachers

The number of applications received in 2004 for 2005 Fellowships is the same as last year.

Applications for 2005 use 105 organisations as hosts, a 10% increase on 2004. In the applications, 86 were to host (or co-host) a single applicant, while 19 were to host more than 1, with one organisation (Massey University) acting as a host for 10 applicants, and two (Department of Conservation and the University of Auckland) hosting 8 each.

The number of applicants and fellowships awarded among deciles is shown in Table 6. The 106 applicants were made up of 54 women, 27 primary school teachers, 4 from composite schools and 76 secondary school teachers, similar to last year's applicants. The 59 fellowships awarded went to 38 women, 18 primary school teachers, 1 from a composite school and 40 from secondary schools.

Table 6. Decile distribution of Applicants to the Teacher Fellowship scheme

Decile	1	2	3	4	5	6	7	8	9	10	private schools
Applicants	6	7	5	9	6	10	11	20	8	20	4
Awards	4	0	4	5	5	6	8	9	5	10	3

A survey of the 2004 Teacher Fellows supports anecdotal evidence that teachers usually become aware of the programme from another Teacher Fellow; 71% replied that this was the way in which they recall first learning of the programme; 14% learned of the Teacher Fellowships from Royal Society presentations, and 5% through media advertising. However, almost all acknowledged receiving information by a variety of ways - from another Teacher Fellow, through advertisements in the Education Gazette, from the RSNZ website, presentations at conferences or in cluster groups, or the RSNZ produced pamphlet. Word-of-mouth and personal contact, while time-consuming, appears to be the most effective method of informing teachers.

The NZSMT Teacher Fellowship scheme undoubtedly fulfils the 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 culture of science and technology;
- advancing professional careers;
- building current and future human capital; and
- encouraging and stimulating young people in science and technology.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

Why Support the Teacher Fellowship Scheme?

The Teacher Fellowship scheme clearly provides teachers with the opportunity to update their knowledge and understandings as well as to rekindle their passion and enthusiasm for their subject. These attributes are then passed on to their students and colleagues, providing them with:

- current and relevant information in the subject;
- enthusiasm and passion for research or technological practise;
- a refreshed and revitalised teacher;
- current information on career pathways for students; and
- stronger relationships/linkages between schools and practitioners at individual and organisational levels

These lay the foundations for future capability and capacity building in research and technological practise. It is extremely important to have highly skilled S&T teachers to provide high quality teaching of pupils that will enable a stream of confident, able, skilled young people to emerge from the education system to benefit the future economic development of New Zealand.

Budget implication – increase the reach of the scheme by more active promotion and support for teachers and hosts

The scheme has proven worth but we think it could include more teachers by extending its reach. There has been a recent increase in teachers involved with the fellowships scheme; however, there has not been a concommittent increase in activity to broaden the reach of the scheme (increase equality and hosts), and an increase in the contract management would enable such activities.

We have the following aims:

- To increase the number of organisations actively seeking to host Teacher Fellows. We have already implemented a website outlining opportunities for Teacher Fellowship applicants to broker matches between hosts and teachers. At least a quarter of the applications for 2005 are projects which may have originated from the information on this webpage. The new hosts now need our assistance to make the most of their relationships with the Teacher Fellows. This has involved much extra work by RSNZ staff, and we would like to continue working closely with the new hosts so that they:
  - become more aware of benefits to hosting Teacher Fellows;
  - develop links with local teacher groups e.g. science hubs; and
  - become proactive in approaching schools.
- To further encourage applications from less-well represented teacher groups, (as described above). The evidence shows that the most effective form of promotion is by word of mouth; unfortunately this is also resource-expensive. The promotions to date are yet to increase the number of applications from under-represented groups. There exist numerous barriers in schools that need to be overcome, such as the inability to get replacement teachers, resulting in a lack of management support. Many teachers still do not know of the existence of the scheme or think that they wouldn't have a chance of success.
- To specifically widen the audience of applicants by targeting a number of fellowships to careers advisers in schools. It is widely held that many careers advisers have been in the school system for several years and have limited experience in the science, mathematics and technology areas. A tailored type of Teacher Fellowship could allow careers advisers to experience a variety of research and technological practise. We would like to develop a more directed form of Fellowship which

would enable school careers advisors to visit a range of organisations and experience various scientific and technological workplaces so that they can experience the range of career pathways available now and in the future for students. In addition they would learn the importance of sciences, mathematics, social sciences, and technology. It is important to enable careers advisors to better inform pupils on different career options in S&T.

- To mentor the Teacher Fellows during their placements, by making use of RSNZ's wide links. For example, by linking Teacher Fellows with Curriculum Advisors around the country, teachers would be able to broaden their curriculum knowledge, and enable Advisors to see what Teacher Fellows achieve in industry/research facilities.
- To provide the necessary support for the new hosts. We have started work on this in the current year by developing a 'Guide to Hosting', and we aim to continue and extend this in 2005.
- To have a second meeting of Teacher Fellows near the end of the academic year. In the past 10 years many Fellows have expressed the wish to meet again towards the end of their Fellowship year in order to share experiences. We believe that this would be highly beneficial and would increase the professional development aspects of the scheme by:
  - assisting with the transition back to teaching;
  - advising on incorporating what they have learnt into their teaching; and
  - reinforcing linkages between Fellows who have worked in similar areas.

We seek an increase in the contract management fee, and in successive years, to enable us to carry out the above as well as to:

- continue working with the biotechnology and design sectors to generate sufficient opportunities for Teacher Fellowships and widely promote these opportunities to teachers;
- more effectively promote the scheme to Māori/Pasifika teachers by traveling to key areas;
- gain even greater dissemination of the learnings of individual teacher fellows (current and past) among their colleagues;
- survey principals, teachers and students to evaluate the scheme; and
- explore the coodination of seminars, conferences, and in-service training courses run by former fellows to impart additional benefits of current knowledge to other teachers.

Suggested Modification to the Terms of Reference

We have requested changes to the terms of reference in the 2003/04 Output Agreement report. These changes are to give clearer explanation that the scheme is for teachers currently employed in a recognised school.

However, as indicated above we believe it would be beneficial to include careers advisors in schools, and we ask that a target of five careers advisors per year be selected for a managed programme. We will develop the outline of such a programme so that these could be advertised at the beginning of the 2005 school year.

TALENTED SCHOOL STUDENTS TRAVEL AWARD

Supporting Promising Individuals includes travel grants to talented school pupils who attended international events. This output is reported on page 75 in the section on Promoting an Innovation Culture.

PROMOTING A CULTURE OF INNOVATION

THE RSNZ SCIENCE AND TECHNOLOGY PROMOTION PROGRAMME OVERVIEW

What a year it has been, with the DNA50 and Transit of Venus programmes coming to fruition. Both ended up being much bigger than our most optimistic expectations. Sponsorship was readily obtained and many rewarding partnerships and friendships were formed, with expats, schools, organisations in the public and private sector, and even whole towns (Whitby and Tolaga Bay). Both programmes proceeded smoothly on a phenomenal wave of goodwill. None of the people immediately involved in the Transit of Venus project will ever forget it.

They are hard acts to follow. What were the x-factors that made them so special, and what does this mean for the future?

Both programmes were centred on great stories about great people. They were a mix of history, science, human interest, adventure, risk, intrigue, with strong national elements. In short, they were interesting, and didn't put people off by just focussing on the hard science. There was something for everyone, and we weren't pushing the science down their throats. Everyone learnt a lot more as a result.

There were lots of exciting and different events, creating many local, national and international news angles. They were personal, involving and exciting.

The Transit of Venus programme allowed students to be creative, and they loved it. They had so much fun making their videos that they never even thought of it as extra work. The magnitude of the prize (trip to the UK), made it highly sought after. The teachers seemed just as motivated as the children. Students with different talents formed multi-disciplinary teams, an achievement in itself, in project planning and execution.

The partnership with Radio New Zealand for the Transit of Venus ensured maximum coverage, and broadcasting the lecture series was an important 'first', vastly multiplying our usual audience.

The programmes were not only collaborative, but they also wove together all the different things we do at the Royal Society: the Rutherford Medal, James Cook Fellowships, Marsden grants, Centres of Research Excellence, the Masterclass! Science programme, the Science and Technology Promotion Fund, the Royal Society Communicators' programme, and the Speaker's Science Forum. This made them very cost-effective.

Our theme for 2005 is 'E=mc2 The Story of the Universe'. This is to mark the International Year of Physics and the 100th anniversary of Einstein's Special Theory of Relativity. Our major sponsor for the Transit of Venus has already committed to sponsoring another video competition. Likewise teachers have insisted we run another video competition, because of its powerful motivating effect.

HIGHLIGHTS

TRANSIT OF VENUS

It is not an exaggeration to say that almost every aspect of the Transit of Venus programme was a highlight:

- The huge response from students, teachers and schools (72 entries in the video competition).
- The excitement of seeing the videos for the first time.
- Making surprise announcements at the three winning schools' assemblies.
- The Tolaga Bay phenomenon, which saw the whole community getting involved in the school's entry and subsequent success.
- The amazing farewell at the Maritime Museum with Naval presence in the harbour and cannon salutes!
- The relationships formed with people in the UK, especially Professor Robin Carrell (ex-pat at Cambridge) and Councillors Joe Plant and Pete Booth in Whitby.
- Bringing the other finalists to Wellington for the Transit of Venus and taking them to see Stonehenge Aotearoa in the Wairarapa.
- The special event at Te Papa on the night of the Transit, including Paul Callaghan's outstanding and inspiring science lecture.
- The very special things the students did in the UK: meeting Stephen Hawking, having a picnic at Trinity College, seeing the first botanic samples collected by Joseph Banks in Tolaga Bay and the first map of New Zealand from the 1769 voyage, and banqueting with the world's top astronomers.
- The homecoming event at Tolaga Bay Area School, and the Navy bringing in the HMS Resolution, just for us. The performances by around 300 students were incredible.
- The joy, inspiration and aroha experienced by everyone who participated.

DNA50 HIGHLIGHTS

Figure 12. **The portrait of Maurice Wilkins**

Highlights of the DNA 50 promotion include:

- The unveiling of the portrait of Maurice Wilkins, commissioned by the Royal Society of New Zealand, at Kings College London, before a gathering of family, colleagues and ex-pats. This was important acknowledgement of Maurice as a New Zealander, the lack of which he has felt keenly.
- The unveiling by Professor Alan MacDiarmid and his two co-Nobel Prize winners of a plaque on the site of Maurice Wilkins' former home in Kelburn, now the site of Victoria University of Wellington. Poet Chris Orsman read the poem specially commissioned for Maurice.
- The gathering of New Zealand's top scientists in the DNA field at the official national launch of the DNA50 campaign at Government House.
- A packed special public lecture by, and launch of the Alpha publication on, role model and ex-pat Professor Alan Cooper, Oxford University. This event was held in partnership with Victoria University of Wellington. Dr Joan Wiffen was guest of honour.
- DNA50 Lecture Tour: four leading New Zealand scientists gave top class talks on DNA themes throughout the year in Auckland, Palmerston North, Napier, Wellington, Christchurch, Dunedin, and other centres.

- "Masterclass! Science: Deciphering the Genome" Dr Neil Hall from the UK's Wellcome Trust Sanger Centre, and Dr Owen White of the Institute of Genomic Research in Maryland, gave a series of seminars to several hundred attendees in 7 centres on their work and its possible applications in the medical field.
- The 'sell-out' lecture and media promotion tour by Oxford Professor of Human Genetics, Bryan Sykes. Professor Sykes is the author of "The Seven Daughters of Eve" and on this tour he was promoting his new bestseller "Adam's Curse".
- The presentation by Hon Pete Hodgson, descendant of Jasmine, of the 2003 Rutherford Medal to DNA pioneer, Emeritus Professor George Petersen, at the DNA-themed Science Honours dinner in Auckland, 13 November.
- The fascinating series of seminars ("Masterclass! Science: DNA in Forensics") by Dr Robin Cotton and Dr Andy Hopwood. Presentations in Auckland, Wellington and Christchurch attracted forensic scientists, police, lawyers and judges, and excellent media coverage in support of our own forensic science facilities and capabilities.

ROYAL SOCIETY COMMUNICATORS COURSES

The Royal Society Communicators courses are always a highlight. Every year, they turn out about 40 young scientists who are well-trained to speak in public, confident about talking to journalists, and enthusiastic about both. This course is practical, encouraging, and always receives great feedback. These user-pays courses are always fully subscribed. There's no reason why they cannot be extended to incorporate 'dialogue' training. We have already been extending the course, at the request of NZTE, to help scientists communicate with, and present to, business people.

PROGRESS AND ACHIEVEMENTS EVALUATION

TRANSIT OF VENUS

The programme consisted of the following:

A video competition for secondary schools with prizes of all-expenses paid trips to the UK for the three winning school teams. 72 entered, twice the number anticipated.

The competition was sponsored by Freemasons New Zealand, the British High Commission (which was successful in applying for extra funding from the Foreign Office), British Airways, British Council New Zealand, Vodafone and Apple.

> *"This is the best competition I have been involved in as a teacher. In the past I've encouraged and supported students as they have applied for space camps etc, entered Science Fairs and/or CREST but nothing comes close to the Transit of Venus Competition.*
> *The students learnt a lot about both the science (in our case - history etc in others) and the technology and filming process. I too learnt a significant amount and found the entire process to be a form of professional development. From this I hope to be more involved in our school intranet and stimulating extension for our more able science students. I hope the Royal Society and Freemasons are able to continue to work together for future projects.*
> *Another valuable aspect is the way in which different areas of the curriculum can all come together and provide their perspectives about a topic. The time in Wellington with students and staff with different 'passions' enriched the whole experience further."*
>
> Faye Booker, St Cuthbert's

> *"On behalf of myself, Lara, Amy and Natalie (the Macleans College team), we would like to thank you and the Royal Society of New Zealand for the wonderful opportunity to explore a stimulating topic, provided to students via this year's competition. We are also very appreciative of the generosity shown to the finalists in bringing them to Wellington and arranging everything so superbly for them.*
> *The girls enjoyed doing the research and making the video immensely. They all developed a new range of skills and delved into a world they had not previously even considered exploring. To their credit, they also did this with minimal help from me as their supervising teacher, thus taking responsibility for their own learning and extending themselves fully. It was an enriching, rewarding experience which ignited an interest in aspects of science they had not previously considered."*
>
> Lesley Shepherd, Macleans College

The Transit of Venus website, www.transitofvenus.co.nz (over 2 million hits at the end of July 2004) was funded by the Science and Technology Promotion Fund and hosted by The University of Auckland's Centre for Distance Learning. This website underpinned the whole programme, and gave the sponsors valuable profile. We have received many compliments about the website, which has a huge amount of high quality information on Pacific voyaging, Captain Cook and his voyages, astronomy, and the history of science.

Dame Anne Salmond (Chief Judge and academic mascot), British High Commission staff, and other sponsors, were despatched in secret to the three winning schools to make surprise announcements at school assemblies. This was high drama and really caught the attention of media, notably TVNZ, which sent a crew to Tolaga Bay to catch the students' reaction to their win.

> *"My goodness what a day it was yesterday. The relief of not having to hold the secret in a moment longer was immense. We, and we hope our visitors, had a wonderful day. The teachers had to write off classes for the rest of the day. Neither they nor the students could concentrate on anything of substance.*
> *…The town is just so buzzing by what has happened. I even went to a tangi this morning and we were the talk of that as well. The older members (and some of the not so old) of our community have literally shed many tears of joy. The sense of community ownership and pride is just so huge. Not to mention educating the whole community on the ToV.*
> *Our council people were just thrilled to be a part of it and the kids are going to present their video and talk about their trip to the whole council tomorrow. The kids have done two radio interviews and I've done a couple as well. The kids said they feel like celebrities…*
> *Such is the buzz in our town that we now have to have an evening to show the video (which they did). We went on the web (actually half the school has probably spent the morning on the website) to look at Pakuranga and Nelson Colleges entries. Great stuff. I can see it was fiercely contested…"*
>
> Nori Parata, Principal, Tolaga Bay Area School, who had to keep the news to herself all weekend and organise a special assembly on the pretext of a visit by Ministry of Education officials.

We had a big farewell event for the Expedition at the Maritime Museum, involving the Navy and all the resources at their disposal – the Admiral and his officers, the band, and one of their boats. This occasion was hugely successful. The Expedition members were ferried from the venue to Devonport, where they dined with Admiral Ledson and his officers. It was an old style harbour-side farewell, with cannons, streamers, lots of cheering, the band playing, and a formal salute by the Navy - emotional, noisy, and memorable.

> *"Just a short note to thank you, the Royal Society, the Freemasons and any anybody else who contributed to the organisation of last week's farewell. I felt really honored to be part of such a special occasion. The manner in which the event was organised and the messages being expressed both contributed to an atmosphere that can only enhance the place of science and social science for those who experienced the event. On behalf of New Zealand science educators please can you pass on our thanks to those responsible. The actual farewell as the students boarded the boat and sailed away was magic creating a very special memory for me."*
>
> Ian Milne, President NZASE

Radio New Zealand broadcast the six-part Transit of Venus lecture series, and did a three-hour live broadcast from Te Papa on the actual night, fronted by Kim Hill. The final inspiring lecture by Paul Callaghan was part of this programme.

> *"I was most impressed with the Transit of Venus address given by Paul Callaghan last Tuesday in Te Papa's theatre. Throughout in both content and clarity it was most easy to follow and of a calibre I seldom hear on radio."*
>
> Peter Lewis Waikato

The Transit of Venus Expedition itself was a major undertaking: nine students, three teachers, three team leaders, two journalists, and representatives from the British High Commission, the Freemasons, and the Royal Society. The teams diverged from London on three separate itineraries, including visits to some of our top ex-pats. These itineraries required considerable organisation, and took advantage of all our UK connections. The town of Whitby put on a civic reception, and went to no end of trouble for the New Zealanders. A number of ex-pats, including Rt Hon. Russell Marshall, joined the Expedition for the Whitby celebration. The British High Commissioner and 1st Secretary also travelled from New Zealand to attend the event. We have invited the townspeople to come to New Zealand (Tolaga Bay) to observe the Transit in 2012.

UNESCO sponsored another Expedition party to Tahiti, where they followed in Cook's footsteps.

The Expedition was such a big thing in so many people's lives (Sara from Tolaga Bay had not even flown before), that we decided to get together in Tolaga Bay six weeks after they returned. The students reported

back to the Navy on the secret instructions they had been given by Rear Admiral Ledson at the farewell, and they showed us some video clips from the Expedition. Admiral Ledson asked the students to recommend a site and concept for the planned New Zealand war memorial in Hyde Park, London.

So taken were the Navy with the whole Transit of Venus programme and the charged atmosphere they experienced at the farewell, that they brought the HMS Resolution into Tolaga Bay and landed ten of their people at the wharf there. The Navy will have no trouble recruiting from Tolaga Bay in future.

Figure 13. The victorious Tolaga Bay team

The homecoming was a spirited, emotional, and significant occasion. The Tolaga Bay school and wider community were the heart and soul of the programme. We have resolved to meet there again in 2012 to see the next Transit of Venus.

The media coverage of the Transit of Venus programme was unprecedented. Over 100 press articles, several TV (1 and 3) news items and one feature, two interviews by Paul Holmes on 1ZB, and saturation coverage on Radio New Zealand. There were also a number of stories on Māori Television, and mainstream media Māori programmes.

Sponsorship:

Sponsorship was sourced from:

- Freemasons New Zealand,
- British High Commission,
- British Airways,
- British Council New Zealand, and
- UNESCO.

In kind contributions were made by

- The University of Auckland (hosted the website),
- Apple Computers,
- Vodafone,
- Maritime Museum,
- The Royal NZ Navy, and
- Te Papa.

The Science and Technology Promotion Fund awarded e-net Ltd a grant to develop the website, www.transitofvenus.co.nz.

DNA 50

Again, this programme was noteworthy for the readiness of people and organisations to contribute.

Thanks to the David and Genevieve Becroft Foundation and the Australian High Commission, the Royal Society was able to invite Professor Jenny Graves, a geneticist at ANU, to tour New Zealand in September 2003. Professor Graves talked to specialist and general audiences in Auckland, Palmerston North, Wellington, Christchurch, and Dunedin, about the rise and fall of the Y chromosome, a popular theme in 2003 as it turned out. She was the first Royal Society of New Zealand Distinguished Speaker.

Figure 14. Bryan Sykes and the lecture in Auckland

Popular science author and human geneticist, Professor Bryan Sykes of Oxford University, was The University of Auckland's 2003 Sir Douglas Robb Lecturer. The Royal Society asked him to extend his tour to other centres, and lectures were organized in Dunedin, Christchurch, Nelson, Wellington and Palmerston North. Professor Sykes' visit coincided with the release of his new book, "Adam's Curse", which is principally about the decline of the Y Chromosome, and the unfortunate consequences for men. This intriguing proposition attracted media attention and consequently strong public interest in his lectures. Every venue was filled to capacity and the quality of his presentation justified the demand. The British High Commission and British Council New Zealand helped finance the tour, including a video conference with

four New Zealand secondary schools, whose students were fascinated by the ability to link people through mitochondrial DNA. The Dunedin lecture, which was sponsored by UNESCO, was a special occasion for University of Otago scientists. It was the perfect opportunity to honour Emeritus Professor George Petersen, New Zealand's 'father of DNA', who won the 2003 Rutherford Medal for Science and Technology. The five new Fellows of the Royal Society from Dunedin were also honoured, along with Deputy Mayor, Dame Elizabeth Hanan, who had been recently elected a Companion of the Royal Society.

Figure 15. Minister Pete Hodgson presents the Rutherford Medal to Professor George Petersen

The Masterclass! Science programme is jointly sponsored by British Council New Zealand, Fulbright New Zealand, Montana Wines and the Royal Society of New Zealand. An extension of the well established Arts Masterclasses, the programme involves bringing a complementary pair of UK and US scientists to New Zealand to give a series of seminars on a specific topic. In honour of DNA's 50th anniversary, the subjects in 2003 were 'genomics' and 'DNA in forensics'. The latter was unusual in that police, lawyers and judges attended the seminars as well as scientists. Local hosts – CRIs, universities, Centres of Research Excellence, and district law societies – took responsibility for organising the seminars and promoting them to interested people.

The first Masterclass!, Deciphering the Genome, was given in June 2003 by Dr Neil Hall from the Wellcome Trust Sanger Institute in Cambridge, and Dr Owen White from the Institute for Genomic Research in Maryland. Both were involved in major genome sequencing projects, with the genome of the most deadly form of malaria having just been completed by the Sanger Institute.

The second Masterclass!, DNA in Forensics, by Drs Robin Cotton and Andy Hopwood, was run from 24 November to 2 December. Dr Cotton is the Director of Technical Forensic Science at the Cellmark Laboratory in Germantown, Maryland, USA. Dr Hopwood leads the Biochemistry Research Group at the Forensic Science Service in Birmingham. Both had intriguing criminal cases to illustrate their presentations. For example, Robin was an expert witness on the O.J. Simpson trial.

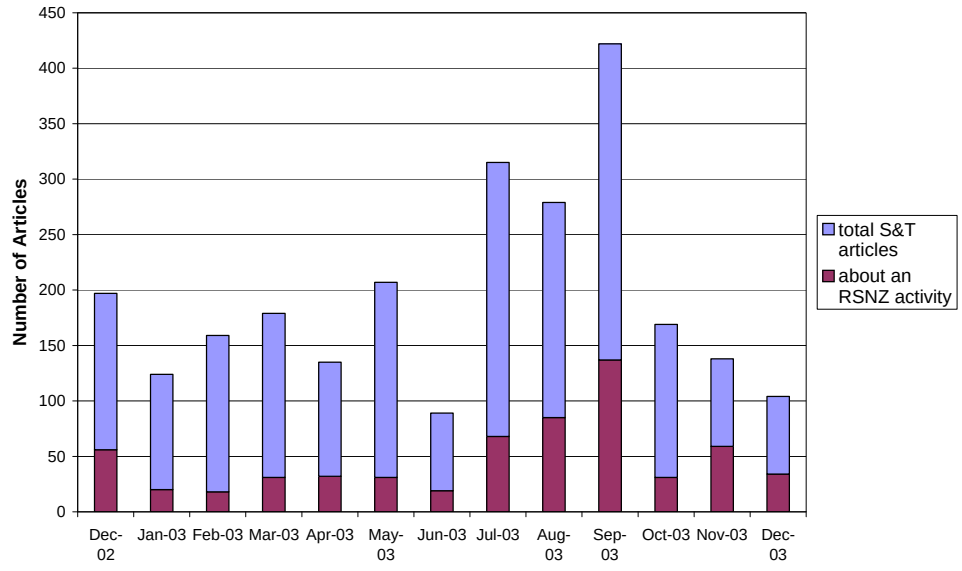
The Masterclass! Science visitors attracted a lot of media attention and have thus been very helpful in educating the public about the applications of our knowledge of DNA and the implications for society. As well as comparing ways of doing things in the UK and US, Masterclass visitors are able to make useful objective comments about the New Zealand situation. For example, Dr Cotton assured the public, police and the legal fraternity, that New Zealand's forensic laboratory facilities are the match of any in the world.

The main events were nicely complemented by a series of locally organized events which took up the theme. The campaign was seed-funded by a one-off grant from the Ministry of Research, Science and Technology. The Royal Society invested its own funds and was able to raise more in cash and uncountable in-kind support.

RSNZ MEDIA IMPACT

In 2003, Royal Society activity resulted in just under one third of all the S&T related press received from its media monitoring agent, as shown in Figure 16. This is the same high level as for the previous period. The Royal Society is very active and effective in working with radio, television and magazines to prompt ideas for interviews and stories. For example, the Transit of Venus programme resulted in a phenomenal level of coverage on television, radio and in the press. On that topic there have been 115 press articles, which will equate to about 20% of the total number of S&T stories, if this year's figures approximate those from the previous two years.

Figure 16. RSNZ's share of total science and technology media articles



POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

The goal of the RSNZ communications team is to increase our funding sources and be as independent as possible. We have achieved this to a remarkable degree in the last two years. We have been able to kick start major nationwide campaigns with relatively small contributions of Government money. These campaigns have incorporated and benefitted many Government funded contracts: Marsden Fund, James Cook Fellowships, the Science and Technology Medals, and the Science and Technology Promotion Fund. Our communications courses are now run on a user-pays basis.

However, the Royal Society cannot support the same level of endeavour from the communications unit as it has had for the last two years, since we no longer have free graduate help from Canadian interns. The more people we have, the more we can do, and the more money we can leverage from other organisations.

No-one else is carrying out this promotional role on a national basis. We are a very effective, dynamic and efficient unit that is making optimum use of Government money. How many other national campaigns have achieved the impact of DNA50 and the Transit of Venus on such modest budgets?

We are currently in the planning stages of next year's campaign, e=mc2 - The Story of the Universe, which is clearly going to be very labour intensive. Two organisations have already asked us to coordinate and manage a number of visits by high profile scientists and educators; they have the money (well, most of it) to bring them out, but not the time to organise them. So, there will likely be just as many, if not more, events to manage, than in previous years. We can leverage more money for such promotional activities if we can offer coordination/management capability.

Although we will do our best in future to obtain sponsorship which covers administration costs as well, our preference is to use every dollar raised to expand the programme. For this reason, we are requesting additional funds to increase our staffing to previous levels and maintain the same high level of S&T promotion in 2005/6.

The Royal Society Communicators programme can be extended to train scientists in the skills required for public dialogue, building on the research carried out under the Dialogue Fund. Courses are currently run on a user pays basis, with Royal Society time given free. We will continue to run them on this basis, but request funds to add a public dialogue module to the courses and expand the database, and to offer 10 free places for Ph.D. students who cannot get anyone to pay for their course fees and are thus excluded. We would work out some suitable selection mechanism. The additional dialogue module can also be offered to scientists who have already graduated from the existing course.

CONTESTABLE FUND FOR SCIENCE AND TECHNOLOGY PROMOTION OVERVIEW

The principal objective of the Contestable Fund for Science and Technology Promotion is to support activities that promote positive values and attitudes towards science and technology at all levels of the New Zealand community. Projects need to demonstrate that they have been developed to achieve the objectives of the Fund, the most important being the promotion of the value of science and technology in interesting, creative, exciting or innovative ways to an audience that is not currently showing a strong interest or understanding

Scope & Scale

In this funding round, 7 projects were funded from a total of 70 applications. This means that the success rate has now dropped to 9%, continuing the downward trend since 1999. 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 (see graphs below). The national impact of the larger projects outweighs the fact that fewer projects can be funded.

In the 2003/04 funding round applicants were actively encouraged to seek commercial sponsorship and an additional assessment criterion to show evidence of sponsorship funding was added to the judging criteria.

Table 7. Providers of promotion programmes

Provider	01/02	02/03	03/04
Professional Society/Interest Group	1	3	0
Charitable Trust	3	2	1
Private Sector	1	1	2
University	3	1	2
CRI	0	1	1
Museum	3	1	0
Student Association	1	0	0

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.

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.

Table 8 shows the number of projects from the three funding rounds 01 - 04 that targeted particular groups.

Table 8. Focus of promotion projects

Target Audience	01/02	02/03	03/04
children	1	4	1
teenagers	2	2	4
adults	2	2	2
parents/caregivers	1	2	0
teachers	2	2	1
Māori	4	2	2
Pasifika	2	2	0
business	2	0	0
entire community (not specifically targetted)	3	3	4
total number of funded projects	12	9	7

HIGHLIGHTS

Noteworthy contracts funded in 2003/04 include a nationwide comedy tour on DNA, quarterly science pages in an online youth magazine, a national touring exhibition of images from the rarely seen world of science research, a TV documentary on the psychological and physiological effects of ultra-endurance racing showcasing the Southern Traverse race and an internationally acclaimed website featuring video-streamed stories, graphics and text on the Transit of Venus and Captain Cook's voyages to New Zealand.

One contract of particular note funded in 2003/04 was Unseen Worlds, a national touring exhibition of stunning images. Scientists routinely observe and create amazing images in their research but these often remain hidden in laboratories. This exhibition reveals these unseen, microscopic worlds in large format (2m square) pictures. Currently on show in Auckland, over the next two years this exhibition will travel to Wellington, Dunedin, Christchurch and Palmerston North. It will then go offshore to Australia.

The second project worthy of note is the Transit of Venus website (www.transitofvenus.auckland.ac.nz) which was designed as a rich multimedia resource supporting the actual Transit of Venus event in June and the national schools' video competition. The website offers a range of original and archive streaming-video and audio resources, with extensive links to relevant material on New Zealand and international websites on the Transit of Venus and Captain Cook's voyages to New Zealand. Between February and July 2004, the site attracted more than two million hits with over 180,000 page views peaking as expected around the announcement of competition winners (27 April 2004) and the Transit (8 June 2004). This enormous level of activity was attributed to the Google internet search engine top listing, links from the BBC website (one of only two) and promotion through the NASA education programme.

> *"It is unlikely that this kind of content would be available to school students as easily and as widely in any other practical way. The University of Auckland supported the website design and hosting, and the transitofvenus.auckland.ac.nz website has been widely considered a great success, for its high quality presentation and content. The innovative use of technology and communications media are hallmarks of e-net's projects."*
>
> Dame Anne Salmond, Professor of Anthropology

As mentioned, the project leveraged a substantial commitment from the Centre for Distance Learning, University of Auckland who are now keen to support a further website being developed for 2005 Year of Physics.

PROGRESS AND ACHIEVEMENTS EVALUATION

The seven projects funded in 2003/04 were: a national touring exhibition of images from the rarely seen world of science research; the Transit of Venus website featuring featuring video-streamed stories; graphics and text on the Transit of Venus and Captain Cook's voyages to New Zealand; two 24 hour BioBlitz events where scientists and the general public come together to document biodiversity; a nationwide comedy tour on DNA; quarterly science pages in an online youth magazine; a TV documentary on the psychological and physiological effects of ultra-endurance racing showcasing the Southern Traverse race; and the engagement of a local disenfranchised iwi community to help clean-up an ex-orchard site with pollutant-tolerant trees.

For a fuller description of the projects funded in 2003/04, and their progress to-date, see Appendix VI.

HOW MANY PEOPLE ARE REACHED?

The Royal Society has collated estimates of the number of people reached by the 9 projects that were funded in 2002/03, and which have now been finished (3 are still ongoing). The following are minimum estimates only; some 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).

- 3090 caregivers and preschool children attended weekly hands-on science sessions
- 400,000 secondary and intermediate school students influenced by Science Role Model calendar
- 90 intermediate students participated in science and technology partnership with local businesses
- 1100 competitors and spectators at regional and national robotic competitions
- 11,000 Stokes Valley inhabitants with science interactives in city centre
- 875,000 households reached with science insert in cereal packets

Total minimum audience 1,290,000

In addition to the above, two projects were funded over two years and had no direct audience during the course of their funding, but both are expected to have a wide reach in the future. One is Stonehenge Aotearoa which will open at the end of 2004 and will have a large and ongoing audience reach as it develops into a research/astronomy education popular science centre. At one stage they were receiving 40,000 hits per day on the website and have had wide press, TV and radio coverage. There has been much international interest including two articles in the UK Guardian newspaper and enquiries from Stonehenge in UK. The other is the Science behind the Garden which will go online in October and will be promoted through 500 garden centres in New Zealand reaching thousands of gardeners across the country.

GEOGRAPHIC COVERAGE

Every year, the selection panel endeavours to select projects that provide a balanced geographic coverage. Table 9 shows the geographic coverage of projects selected in 2001/02, 2002/03 and 2003/04. In 2003/04 the panel selected larger projects with a national reach to increase the audience coverage.

Table 9. Geographic distribution of Promotion Fund projects

	01/02	02/03	03/04
All New Zealand	3	4	5
North Island	-	1	
Auckland	3		1
Wellington	1	2	
Wairarapa	-	1	
Waikato			1
Canterbury	1	-	
Otago	1	1	

MEDIA COVERAGE

Some projects generate a great deal of media coverage, extending their reach beyond the direct participants in a programme. Table 10 gives the media coverage from January 2003 to July 2004.

Table 10. Media coverage for Promotion Fund projects

Year	Project	Press	TV	Radio
2002/03	Summer of Discovery	1		
	Stokes Valley Science Initiative	5		Local
	Robotic Olympics	7	TV3 News	Local
	Porirua S&T Partnership	2		
	Role Model Science Calendar			
	Good Morning Science	1		
	SciBoard			Local
	Stonehenge Aotearoa (not yet completed)	7 3 specialist	TV3 News TV3 documentary	Radio NZ
	Science Behind Your Garden (not yet completed, online Oct 2004)	Exp. Oct		Exp Oct
2003/04	'Unseen Worlds' exhibition (ongoing)	2	TV3 News	
	Transit of Venus Website (as part of 2004 Transit of Venus campaign)	110	6 TV1/3 News	Saturation for 2 days on Radio NZ
	BioBlitz (event 2004, event 2005 to come)	4	TV1 News TV3 News	Radio NZ
	'Life's What You Make It' comedy tour (completed	2		Local
	SciTech:quarterly science pages in TEARAWAY (ongoing)	Teenage magazine x 4		
	'100 Hours of Exercise' documentary (completed)	5 2 specialist	TV1 Sky x6 Regional	Radio NZ x5 Local x2
	Healing the Land (ongoing)	1		Local

Figure 17. **100 Hours of Exercise participants**

Figure 18. **Stonehenge Aotearoa**

EVALUATION STUDY

We are undertaking an evaluation of the Promotion Fund, to investigate:

- the longer term impacts of funded projects;
- the effect of different project characteristics on project outcomes; and
- the role of alternative funding sources for promotion activities.

This evaluation is being carried out in conjunction with Victoria University of Wellington. The leaders of 10 completed projects have been interviewed to investigate longer term outcomes, and unsuccessful applicants from the last three years have been surveyed to find out about alternative sources of funding. Analysis of the data is currently underway, with some interesting and unexpected preliminary findings emerging (please note that at this stage, these results are indicative only):

From the survey data (i.e. projects that did not receive Promotion Fund monies):

- Around 37% of projects that did not receive funding from the Promotion Fund, nevertheless proceeded, although usually in a modified form. Modifications were made in order to fit projects

into reduced budgets, to align projects with sponsors' criteria, or to better reflect the applicants' original aims.

- The Promotion Fund was not the "first port of call" for funding in just over half of projects: 56% had made applications to other sources prior to applying for a grant from the Promotion Fund.

From the interview data (i.e. projects that did receive Promotion Fund monies):

- Most interviewees appear to see the Royal Society as the owner of promotional activities in New Zealand in general and would like to see the Royal Society take a more "hands on" role.
- Most interviewees felt that the funding that they received from the Promotion Fund gave their project a hallmark of quality, and that the Royal Society (and the funds it administers) has significant stature and respect in New Zealand.
- Only two of the ten project leaders said that their funded project had definitely not led to any further activities.
- Eight of the project leaders said that the project developed new capabilities and skills in them or their organisations.

The full and final results of this evaluation will be reported in early 2005 and the findings will inform any suggested policy changes to the Promotion Fund. These policy changes will be discussed with MoRST at that time.

COMMERCIAL SPONSORSHIP OPPORTUNITIES

During 2003/04 MoRST contracted the NZ Sponsorship Agency to work with the 17 projects that reached Stage 2 of the 2003/04 application round. Of these NZSA identified 7 projects that were ideal for commercial sponsorship and the remaining 10 had no funding requirement and/or limited potential for obtaining sponsorship. NZSA gave assistance to the former by helping to identify potential sponsors, structuring sponsorship proposals and helping with sponsorship negotiations. To date, none of these projects have gained any commercial sponsorship.

To encourage applicants to seek other sources of funding, projects were required to show evidence of commercial sponsorship in their 2003/04 applications. This brought into the sector additional funding with an equivalent amount of in-kind sponsorship.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

The Science and Technology Promotion Fund delivers excellent value for money and is often used by projects to leverage additional commercial sponsorship monies. In 2003/04, the fund was effectively increased by 29% by commercial sponsorship monies obtained by project leaders. Commercial sponsors are most attracted by the amount of media promotion linked to a project and in the media and promotional area, it is advantageous to have a third party with a national media capability acting with the projects to get a wider reach. The two recent projects which have been most effective in this area (Stonehenge Aotearoa and Transit of Venus website) were both integrated under the RSNZ's major annual theme and benefited from the co-ordinated services and attention this provided. This also empowered project leaders to raise sponsorship and provide a better return on investment. Conversely, it is obvious (see Table 10 on media coverage) that individuals and small professional societies do not have the in-house capability to generate an effective media campaign. The Royal Society is supportive of the development of a Science and Technology Promotion Sponsorship Hub as a natural extension to the Science and Technology Promotion Fund and has submitted a strong bid for this project. It is interesting to note from the evaluation study of the Promotion Fund that the science community would like to see the Royal Society increase its role in the coordination of science promotion (see Evaluation Study above)

Each year the variety of imaginative projects to apply for funding is large but the bids amount to ten times the available funding. The Fund now gives larger awards and this has enabled stronger, more effective projects to proceed. 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. However, the consequence of this policy is that fewer projects are successful in gaining funding and the number of disappointed applicants has risen still further. It has been the general policy of the Assessment Panel not to offer full-cost funding but to encourage the larger institutions to match Promotion Fund monies with in-kind sponsorship. This has been an effective method of gaining excellent value for money from the Fund dollars.

BUDGET IMPLICATIONS

The Royal Society recommends a 20% increase in the Promotion Fund to support the continuing strong demand for science and technology promotion activities in the community. Despite the change in criteria which ensures some sponsorship is included in each project's budget, the number of very worthy projects being turned down is increasing year on year. The Promotion Fund received a 5% increase in 2003/04 and we recommend a larger increase in the coming year to maintain the 'buying' capacity of the Fund.

CHANGE TO TERMS OF REFERENCE

There are some issues that need clarifying with respect to the criteria for eligibility and the nature of sponsorship. These will form part of ongoing discussions with MoRST on policy changes to the Promotion Fund.

As there is currently no full-cost funding directive for this Fund, we seek clarification or a directive that enables the continued value for money from the Promotion Fund that the Government gets with the current partnership deals.

FOSTERING TALENTED YOUNG NEW ZEALANDERS

OVERVIEW

The supply of human capital for research, science and technology faces some critical threats, coming from a lack of capacity to replace an ageing scientific workforce[14]. In addition, there are continual references made to the worrying lack of science, engineering and technology graduates. We graduate a lower proportion of people in science and engineering than the OECD or EU averages. The consequence of this is that there are fewer graduates (and even fewer New Zealanders) to either supply the teaching profession, to provide role models to enthuse students in science, mathematics and technology (S&T), and to provide the essential skills needed for the future of a robust economy. The problem is therefore self-perpetuating.

The Royal Society's objective in encouraging talented young New Zealanders is to enthuse, stimulate and encourage young people into scientific or technological careers, and to encourage those who do not pursue such careers to gain a sound grounding and understanding in sciences and technology. The Society believes this is crucial to strengthening New Zealand's future talent in S&T.

We do this in three main ways:

- identify and communicate with young New Zealanders who show potential in research and technological practise;
- support them in their research or technological practise; and
- recognise their achievements through awards, participation in scientific activities, and scholarships to international events.

The latter also gives students experiences of other cultures, and builds foundations for New Zealanders' participation in the global community.

We encourage young achievers through a variety of programmes, some contracted by MoRST, and others sponsored by non-Government sources, such as the BP Challenge, or by ourselves such as the CREST Awards. We support additional activities through our association with the science, mathematics, technology and social science teacher associations.

The activities currently contracted by MoRST are:

- development and coordination of a national celebration and promotional event in December 2004 for high achieving school students in research and technological practise. This is event is known as Realise the Dream.
- selection, administration and gaining sponsorship for young achievers to participate in international research and develop links with international researchers and students; and
- identification of and communication with young achievers.

[14] Pool, I. and Honey, J. 1999, "Appendix III: The Scientific Workforce: Implications for New Zealand's Future Science Infrastructure" in "Leadership Priorities for New Zealand Science and Technology", Proceedings of a conference sponsored by the Academy Council of the Royal Society of New Zealand, 5-6th November 1998

REALISE THE DREAM

Realise the Dream is a 5 day national celebratory and educational expo held at the end of the school year for high achievers in research and technological practise (sciences, mathematics, social sciences and technology). It is designed to build a strong culture for sciences by:

- building on the foundation provided by our young;
- providing an incentive for achievement;
- encouraging and acknowledging young people in their development of creativity and lateral thinking in sciences, technology and entrepreneurialism; and
- supporting parents and educators to inspire our future wealth creators.

The programme for 2003 included workshops for the participants on presentation skills, speaking skills, and intellectual property; visits to research and technological organisations; demonstrations, and visits to sites such as IRL and GNS; and a celebratory dinner. Realise the Dream 2003 brought together 32 students from New Zealand ranging in age from 13 to 18 years, two students from Taiwan and one from the USA. All students had demonstrated excellence in science, technology, social science and mathematics.

A celebratory awards dinner was held where participants were recognised for their achievement. This was attended by 150 including representatives from CRIs and other scientific organisations.

> *"The most professionally managed and realized celebration of science achievement I have attended. It lifts the Awards into a whole new realm, creating the sort of ambience around the Awards which mark them as significant accomplishments usually reserved in our culture for sports winners. The challenge is to ensure that the event continues to be adequately resourced so as to build its profile with the media, those vital intermediaries in the science/society dialogue – and also builds the equally essential word of mouth endorsement from attendees."*
>
> Anthony Scott, Executive Director, Association of Crown Research Institutes Inc

> *"Thank you so much for this amazing experience. Despite being a 'historian', it has been both incredibly interesting and certainly very different to have been exposed to such innovative and ground breaking technology and science and talk to some amazingly intelligent people whose obvious passion for what they do is very inspiring. Thank you for giving everyone the chance to participate."*
>
> Realise the Dream participant

While Genesis Energy, the principal sponsor, has committed to a two year sponsorship and other sponsors are happy to continue to sponsor awards, the future of Realise the Dream is by no means secure as it depends almost entirely on sponsorship.

The vision for Realise the Dream is eventually to remove all barriers to student participation and to allow open nomination of hundreds of pieces of work, rather than the current limited process which invites nomination from existing programmes. This will require a rigorous, fair and inclusive selection process to enable a high standard at the Realise the Dream event.

Figure 19. **Realise the Dream 2003 participants photo**

MANAGEMENT OF SELECTION OF STUDENTS TO PARTICIPATE IN INTERNATIONAL EVENTS

We sent the greatest number of students on international experiences ever: 56 students and three teachers have been assisted to travel to international science and technology events in July 2003 – June 2004 period. The selection process is carried out by teachers, scientists and sponsors.

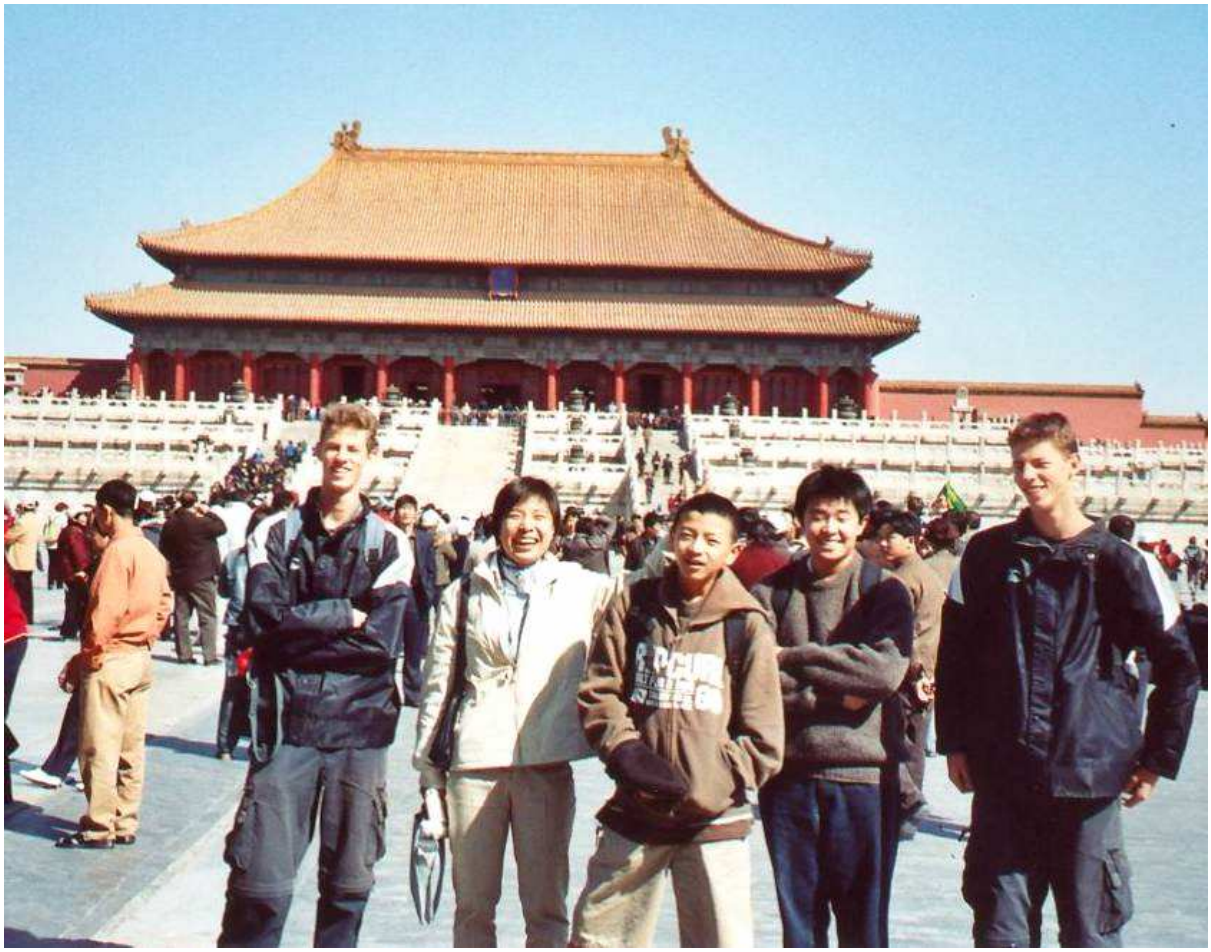
Of these students, 35 received assistance from the Talented School Students Travel Award. Other organisations such as the British Council and Asia2000 also assisted in funding students to attend international events.

Events attended by New Zealand students for 2003/04 were:

- USA Space Camp
- Australian International Space School
- Taiwan Science Fair
- APEC Youth Science Festival
- Beijing Youth Science Creation Competition
- London International Youth Science Forum
- SEAMEO 3rd Congress, Penang
- Biofutures Conference (Brisbane)
- Future Problem Solvers, 2 – 6 June, Kentucky
- Global Young Leaders Conference – Hague, 25th – 30th January 2004
- Maths without Limits: Izmir, Turkey October 2003
- International Chemistry Olympiads
- International Maths Olympiads, Athens, Greece

Australian International Space School attendees

Figure 20. **Beijing Youth Science Creation Competition winners**



The decile ratings of schools represented by students selected through the Royal Society to attend international events were more evenly spread compared to decile ratings of those who applied for assistance through the Talented School Students Travel Award Fund. This is to be expected as activities such as the Olympiads draw from the academic elite, most of whom attend high decile schools. We would very much like to be able to target lower decile schools in our promotion of the Travel Fund. The management fee required to allow us to meet the costs of such an activity would currently be large compared to the size of the fund.

> *"On behalf of my brother, I would like to extend our gratitude and thanks for awarding funds for us to travel to 'Maths without Limits' in Turkey. There were 55 competitors from 6 different countries. We felt there was a lot of benefit attending the event, especially in meeting other competitors. Without your assistance it would have been more stressful for Mum and Dad to find the funds. Thank you."*
>
> TSSTA awardee

Figure 21. **Students selected for attendance at international events through RSNZ**

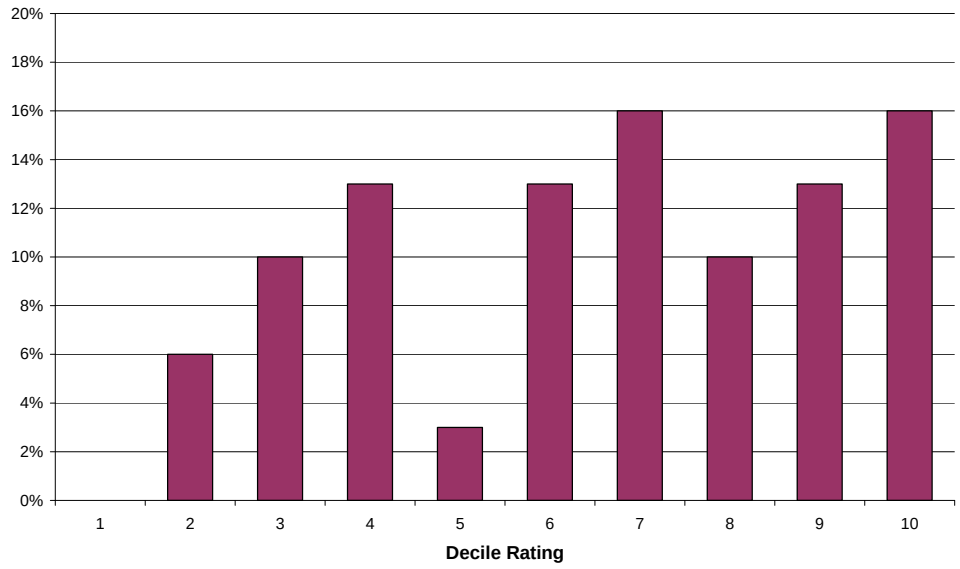
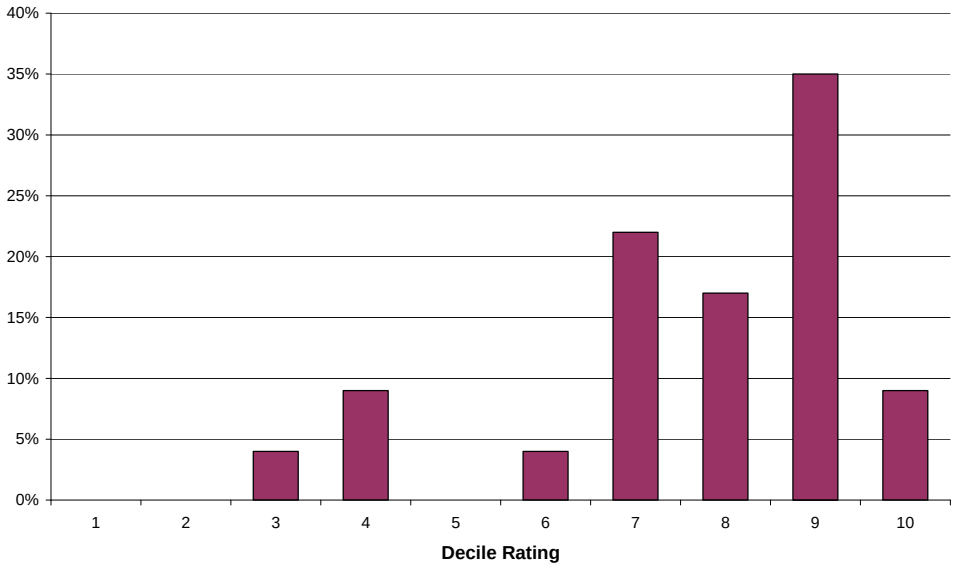


Figure 22. **Decile ratings of students selected for the TSSTA Fund**

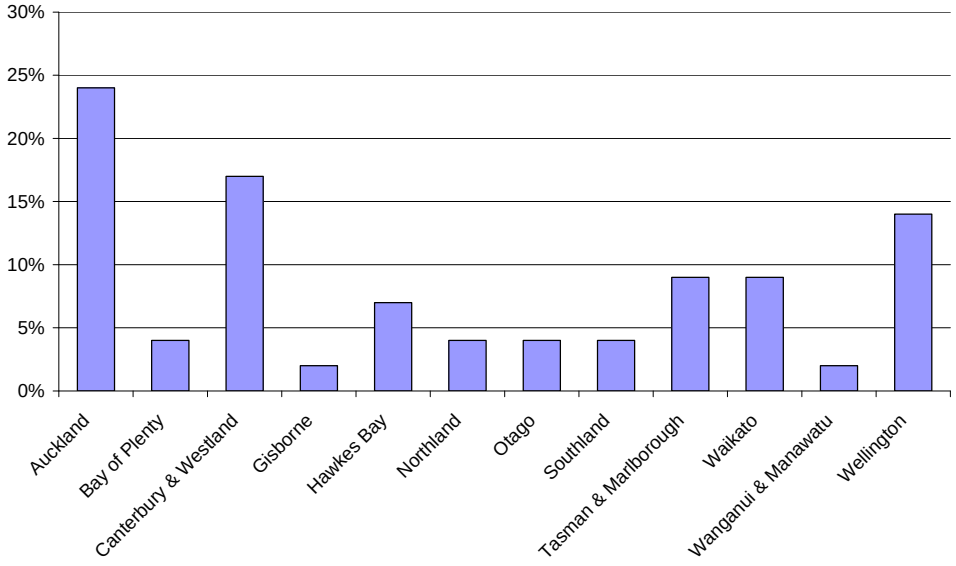


"Biofutures was an inspirational experience for me. It not only filled me with additional knowledge but allowed me to realise how much fun science can be when you are with enthusiastic like minded students with similar interests. It has opened my eyes to what awesome opportunities lie ahead in the bioechnology area. I could not have afforded to go to Australia, so thank you again for your support."

TSSTA awardee

The percentage of students selected from regions to attend international events is fairly equitable to those regions (Figure 23).

Figure 23. **Distribution of students selected from each region to attend international events**



HIGHLIGHTS

Significant media coverage is generated by the young achievers, particularly in community newspapers but also on radio and television. This helps promote the value of science and technology and the opportunities that are available.

One of our talented young New Zealanders is Natalie Crimp. Natalie has been a participant at previous National Science and Technology Fairs and also Realise the Dream in 2003. She won an award for her investigation into composting disposable nappies. Her work created a huge amount of media interest and she appeared on the Breakfast Programme and also National Radio as well as appearing in various newspapers. Her award enabled her to travel to the 'Search for Young Scientist' in Penang earlier this year where she also won an award for her work.

Figure 24. **Natalie Crimp, one of our talented New Zealanders**

The involvement of three of our young New Zealanders at the APEC Science Ministers' Conference was a highlight for them and for us. Three of them also presented to a MoRST Chatshop; again an exercise that

boosted their belief in their choice of study area and an opportunity for Government officials to meet some inspiring young New Zealanders.

PROGRESS AND ACHIEVEMENTS EVALUATION

YOUNG ACHIEVERS DATABASE

Our database currently holds information on 740 young achievers aged from 9 to 24. They have been drawn from programs such as Science and Technology Fairs, CREST, and students who have been selected for international events.

We continue to support these achievers by informing them of recent developments in scientific and technological practise and opportunities such as scholarships and competitions.

The database has been redeveloped during the first half of 2004, to be much more inclusive and interactive. This will allow greater flexibility in extracting information so that our ability to target particular groups of young achievers is possible.

The database has been used to identify young achievers for particular events such as the APEC Science Ministers' Conference. We have been able to suggest young New Zealanders for involvement in occasions that promote science and technology and demonstrate the capability of New Zealand's future scientists and technologists. Such activity has been very beneficial for the young people invited.

CREST — CREATIVITY IN SCIENCE AND TECHNOLOGY

CREST is a national awards programme which provides a framework to support and enhance the quality of students' educational experience in science and technology within New Zealand. Undertaking a CREST Award gives pupils authentic experience in scientific investigation or technological practise of their own choice, working with an outside consultant/expert to investigate issues of real significance in their lives.

CREST encourages and rewards creative and innovative thinking, the application of existing and the seeking of new knowledge, risk-taking and perseverance in the face of adversity. It develops communication skills and tacit knowledge. An important foundation stone of the Growth and Innovation Framework, it encourages excellence in science and technology in young New Zealanders, who may well go on to be the innovative entrepreneurs of the next decades. Students can showcase their work at regional science and technology fairs and national S&T competitions, and individual CREST projects have been publicised in newspapers and on television. Winners of the fairs and competitions have gone on to win international S&T competitions, showing that New Zealand youth are competitive with the best in other countries.

This programme provides exposure of the students to role models from knowledge-based, wealth-creating industries, heightening their awareness of career options and making real business-education links. Students' teachers, families and local communities are reciprocally exposed to their projects, thus CREST may be credited for both encouraging pupils into science and technology careers as well as increasing scientific and technological literacy in society.

The CREST scheme sits within the New Zealand Curriculum Framework as a rich curriculum support activity and offers both the improvement of technological literacy at the lower levels, and an extension of extremely able students in research and technological practise at the higher levels. From a student's perspective features such as the incentive of an award, working with outside consultants/experts, accepting responsibility for their own learning, and the opportunity for multiple assessment (including NCEA credits), have great appeal and provide a high level of motivation to produce excellent work.

Haydn Luckman, a second-year student at the University of Auckland Engineering School and Gold CREST awardee, believes that an interest in science has to be fostered at an early age:

Figure 25. **Helen Anderson presents Haydn Luckman with his CREST award**

> *"Time and time again I talk to science students like myself who have got hooked on science at an early age and it is this that has led them to study it at university."*

But Haydn is emphatic that the right messages are not getting through to primary and secondary students who desperately need information regarding careers in science and technology in time for them to make crucial decisions.

> *"I cannot stress this point enough—there is a definite break in the chain of information, somewhere between the secondary and tertiary levels. When I was at school, the closest anybody ever got to answering questions relating to further study and careers, was 'just study what you like and worry about a job later'."*

He says 'The CREST awards "helped me to foster an enquiring mind and passion for knowledge" and without this he would never "have got hooked on science and technology - it is as simple as that."

Table 11. The CREST programme

Years 6, 7, 8	Years 9, 10	Years 11, 12	Years 12, 13
First CREST	Bronze	Silver	Gold CREST
Team First	Team Bronze	Team Silver	

The programme has four progressive project stages (First CREST, Bronze, Silver and Gold), providing for small entry level projects through to large research projects that can take up to 18 months, providing the potential for major new discoveries and publications. The awards are non-competitive, standards-based and are applicable to students of all abilities. Student achievement is assessed on creativity, perseverance and the application of knowledge. All students are encouraged to work with people in the community other than their teacher, but for Silver and Gold CREST awards, consultants and assessors from outside their own school community are required and have clearly defined roles.

The CREST Award scheme is developing steadily under extremely limited resources. Despite its struggling for sponsorship within the New Zealand educational climate, CREST has nevertheless had some impressive achievements. These include: running 'Innovating with Industry' workshops for Silver and Gold students, organising 'Gold Presentation' displays, and carrying out complete booklet rewrites. In the last three years, a total of 6,644 students nationwide have received a CREST award for the successful completion of their projects at various levels. Sponsorship is actively being sought, and promotion of the scheme to all schools is now occurring at a much higher level. Linkages and synergies with other programmes such as Futureintech, and science and technology fairs are being actively pursued, as is the adaptation of materials to make them more accessible for under-represented groups.

Our future aim for CREST is to establish an Award scheme subscribed to by at least 80% of the 592 secondary, composite and intermediate schools, supported by a network of regional facilitators (part-time). These regional facilitators would operate under the guidance of a national Advisory Board which would be a committee of the RSNZ. Assessment would be carried out by a team of national assessors under the direction of the Chief National Assessor. A database of consultants and technical assessors would be maintained by the CREST National Director (a RSNZ position) to support young people and their teachers. The ultimate goal is that the support and recognition provided by the scheme is available to all young people.

Our education system is based on a belief of the value of investing in the future of our nation through our young people. We must begin at school. Development of interest and excellence in the fields of science and technology in our young people underpins the human capability requirements for New Zealand's future. The CREST scheme leverages off the talent and enthusiasm already existing in our youth, in order to reap the human capital dividends for the wealth-creating industries of tomorrow.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

We all acknowledge that the future lies with the young. It is time that we realized this by committing serious resource to activities which involve the young and encourage, support and promote them into scientific and technological careers which will benefit New Zealand's economic, social and environmental future. This is best done through a secure funding stream from which additional sponsorship might be leveraged, but should not be relied upon.

BUDGET RECOMMENDATIONS

The CREST Award scheme requires ongoing support for its operation. This is made up as follows:

We need the infrastructure to run the scheme including staff costs. In addition, we need operational costs for promotion of the scheme, support for the approval and assessment of student projects, support for teachers and students and the provision of several nationwide workshops for teachers. The workshops would introduce the scheme to new schools, and explain to teachers how to run the scheme within existing curricula and assessment frameworks including NCEA. The RSNZ staff costs would enable us to establish a national network of facilitators, consultants and assessors to provide the necessary mentoring and support that is integral to the scheme.

Realise the Dream requires ongoing support per year to operate effectively, as described below:

To enable the vision of an expanded participation by students in Realise the Dream, this scheme requires the infrastructural support of RSNZ staff to manage the programme and to pay for the costs of running a credible selection process with training and accreditation of selectors. This will result in a high profile nationatl event with a fair, rigorous and inclusive selection process.

The cost of the event itself will continue to be met by sponsorship from external sources.

A small management fee is required to allow effective promotion of the Talented School Student Travel Fund to students in low decile schools.

NEW ZEALAND SCIENCE AND TECHNOLOGY MEDALS

OVERVIEW

The Rutherford Medal is the highest award instituted by the Royal Society of New Zealand at the request of the Government 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 sciences, 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 practise by a person or group in any field of science, mathematics, social science, or technology. A group award shall only be made in very meritorious circumstances.

Silver Medals are awarded to honour men and women who have made excellent contributions to the fields of science, mathematics, social science, and technology. The Royal Society looks for people who meet the following criteria:

- have made a conspicuous long-term contribution to science, industrial research, or science education; or
- have made a conspicuous long-term contribution to the promotion of the public awareness of science, mathematics, social science, or technology. Up to 10 Silver Medals will be awarded annually to individuals.

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 of science, mathematics, social science or technology;
- have made a significant long-term contribution to science, industrial research or science education; or
- have been involved in the significant advancement of, or promotion of, science, mathematics, social science, or technology in some other way.

HIGHLIGHTS

Emeritus Professor George Petersen FRSNZ from Dunedin was awarded the 2003 Rutherford Medal for his exceptional contribution in pioneering methods for sequencing DNA and nurturing the development of DNA research in New Zealand.

Professor Petersen became interested in the Watson and Crick's proposed double helical structure for DNA as a young Ph.D. student at Oxford University in the 1950s. When he returned to New Zealand in 1959, Professor Petersen was the only scientist in New Zealand working in the DNA area. He has devoted his life to DNA over the last 40 years, pioneering the development of methods to determine its sequence, and then to understand its significance for biology. He nurtured the development of DNA research throughout this period of dedicated service to New Zealand science, training a generation of scientists who have gained international prominence. Professor Petersen established a highly successful and widely accepted regulatory scheme for the use of genetic engineering in New Zealand in the 1970s. His continuous and inspirational enthusiasm for the potential of DNA to be a major and positive influence for New Zealand society has resulted in Professor Petersen being acknowledged as New Zealand's 'father of DNA'. It was therefore appropriate that he received this prestigious award in 2003, the 50th anniversary year of the discovery of the helical structure of DNA.

Professor Petersen 'retired' in January 1999 after 31 years as Professor of Biochemistry at the University of Otago.

Professor Petersen was presented with his Rutherford Medal at a special local ceremony, attended by his peers and family, at the University of Otago in Dunedin in October 2003. He was also formally presented with the Medal by the Minister of Research, Science and Technology, Hon. Pete Hodgson, in the presence of over 200 scientists and technologists at the inaugural Royal Society of New Zealand Science Honours Dinner held in Auckland in November 2003. This occasion provided an excellent opportunity to promote and celebrate the very best in science and technology in New Zealand.

EVALUATION

In 2003 there were four nominations for the Rutherford Medal, and 12 nominations for Science and Technology Medals (1 in engineering; 8 in science; 1 in education; 2 in mathematics). One Rutherford, two Silver and five Bronze medals were awarded. These medals were presented at various local ceremonies around the country during the latter part of 2003. Professor Geoff Duffy, Dept of Chemical & Materials Engineering, University of Auckland, was presented with his Silver Medal for his exceptional contribution to industry and the community in the field of fluid mechanics of fibre suspensions, by Ministry of Research, Science and Technology Chief Executive, Dr Helen Anderson.

In recent years the Rutherford Medal has taken on even greater prestige, and as a result more excellent nominations are being received for it.

In 2003 the number of nominations for Science & Technology Medals was down on that of 2002 (21 nominations) particularly in education, and the trend has continued in 2004 with 13 eligible nominations with the ratio and range of disciplines very similar to that of 2003. Three years ago the criteria for award of the medals were strengthened and tightened and since this has become known fewer, but higher quality, nominations have been received which would help account for the drop in the number of nominations. The reduced number of nominations may also have resulted from a perceived possible overlap with election as Companions of RSNZ; this class of membership was introduced in the Royal Society of New Zealand Act 1997.

The Royal Society has introduced its new Pickering Medal this year to recognise excellence and innovation in the practical applications of technology. At closing date of 30 June 2004, five nominations had been received. This Medal, although non-MoRST funded, is intended to fit into the hierarchy of the Science & Technology Medals, at a slightly lower level than the pre-eminent Rutherford Medal for science and technology, but above the Government Silver and Bronze medals.

The Royal Society will be undertaking a review of all the medals it administers in early 2005, comparing them with the suite of medals offered throughout New Zealand in various areas of S&T. The review will focus on how best the suite of medals in NZ serves to celebrate the diversity of effort by science and technology researchers and practitioners.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

In 2003 the Royal Society recommended to the Ministry that it consider adding the Pickering Medal to the suite of New Zealand Science and Technology Medals and that funding of the medals be increased to cover costs of striking the new medal and to cover costs relating to holding an award ceremony and Royal Society administration. This funding request was declined but as mentioned above the Royal Society has decided to introduce a Pickering Medal anyway.

Hopefully the 2005 review of the Medals will ascertain the position of the New Zealand Science & Technology Medals in the national medal environment. Discussions are under way concerning the possible introduction of Karl Popper and Joan Metge Medals in the social sciences and a Hillary Medal for Antarctic Science and once the introduction of these Medals is confirmed, the Government will be approached to see if these medals could be incorporated into the Science & Technology Medal suite.

The naming of the Science & Technology Medals should be reconsidered. The medals have been categorised in various ways over the past 10 years, most recently as Rutherford, Silver and Bronze. The newly increased prestige of the pre-eminent Rutherford Medal is well recognised but it might be best to lump the Silver and Bronze Medals together again and call them Science & Technology Medals. As the two classes stand at

present, the question has been raised as to whether a person who received a Bronze Medal, say last year, can be nominated for a Silver Medal down the track. Following the review a recommendation will be made regarding the naming of medals and the terms of reference, to clarify the purpose and eligibility for each medal type.

SCIENCE AND TECHNOLOGY PUBLICATIONS

JOURNALS PUBLISHED BY THE ROYAL SOCIETY OF NEW ZEALAND 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:

- New Zealand Journal of Agricultural Research
- New Zealand Journal of Botany
- New Zealand Journal of Crop and Horticultural Science
- New Zealand Journal of Geology and Geophysics
- New Zealand Journal of Marine and Freshwater Research
- New Zealand Journal of Zoology
- Journal of the Royal Society of New Zealand

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 on behalf of the Government, are largely regional in scope but have a global reach. They are of unique value to the New Zealand region, but they also extend to a wider audience, particularly within the Southern Hemisphere and western Pacific United States. All journals are sold internationally with 60% of subscriptions going overseas.

The Society advocates the recent international trends towards Open Access of scientific information, whereby the results of funded research are made available on the internet without restriction. Through Open Access, knowledge is freely disseminated to as wide a potential readership as possible, thereby facilitating one of the main aims of scientific research and advancement—the interchange of ideas and information. The national journals published by the Society are developing the Open Access model, and funding for this is provided variously through a system of publication charges (individual author page charges, through institutional research funds, or by direct Government funds for publishing).

Recent funding increases are being used to restore editorial resources and alleviate the deficit that arose due to inflationary pressures over the last ten years. This will ensure that the relevance and importance of the journals is strengthened, and that their performance in providing a service to authors and users is improved and enhanced. Material will be evaluated and published more quickly, ensuring that the information is up-to-date and applicable to related studies throughout the globe. This will highlight the significance of New Zealand's research and bring it to the attention of the world in prompt time. The increased governmental funding will also allow for the introduction of the new social sciences journal.

Governmental funding is a crucial component in making journal publication possible. Under the present subscriber-based system for print journals, Government funds complement subscription revenue by one-third. However, under Open Access, subscription revenue will decrease, and increased governmental funding (directly or indirectly) will be required to sustain the dissemination of scientific knowledge that the journals provide.

HIGHLIGHTS

PROCEDURAL HIGHLIGHTS

The Society has been developing the system of Open Access for the journals. This has meant a change in emphasis from a subscription-based operation to a funding-based one. Currently, income for the journals is received from subscriptions, page charges and Government support. Once Open Access is fully in place, the journals will be supported by full page charges. Researchers receiving full-cost funding will receive support for these page charges in their grant applications. It is expected that there will be some Government support, on a public good basis, through page charge waivers for researchers not receiving full-cost funding. There will be a decreasing reliance on receiving subscriptions, and more effort is in recovering cost through publication charges. In return, current and potential journal users have easier access to information through the provision of online publication and they have less need for an individual subscription. However, because both print and online journals are now produced, a certain amount of cost recovery through subscriptions remains necessary to cover the printing and distribution costs. Some developments in our procedures over the last 12 months include:

- providing the journals online, together with the print version, on subscription from 2003;
- instituting a nominal page charge to authors for all papers submitted from 2003;
- introducing a page charge waiver system for submissions from authors with no funding mechanism for publication;
- enlarging the regional scope of the journals to include the Southern Hemisphere;
- improving our electronic manuscript handling and tracking procedures, including submission, reviewing and proofing processes;
- publishing papers online a few weeks before print publication;
- begin digitising back issues to become freely available online from 2002 back to 1994;
- publishing special issues and organising future additional special issues of some journals;
- increasing the amount of colour content in the journals;
- introducing full-colour covers on the printed journals from 2004;
- trialling the use of an honorary editor for one of the journals (JRSNZ); and
- increasing the international content of some of our editorial boards and changing the composition of others.

PUBLISHING HIGHLIGHTS

Papers of special significance:

Example 1. New Zealand Journal of Botany

The March 2004 issue of New Zealand Journal of Botany (NZJB) (Vol. 42 No. 1) carries the first in what is intended to be an annual series of invited review articles, the Godley Review. The series is named for Dr Eric Godley, a former director of DSIR Botany Division (the forerunner of Landcare Research), who was instrumental in establishing NZJB. This first paper is titled "Winter leaf loss in the New Zealand woody flora" by M. S. McGlone, R. J. Dungan, G. M. J. Hall, and R. B. Allen.

The senior author, Dr Matt McGlone, has had an interest throughout his career in climate, vegetation history, and biogeography in New Zealand. One outstanding issue has been the relative lack of deciduousness in the native flora; approximately 27 species (c. 5%) of the New Zealand woody flora have a marked loss of leaves in winter, although only 10 species are consistently fully deciduous and no extensive vegetation type is dominated by them. Dr McGlone decided to tackle the problem by answering the question of whether or not the current climate of New Zealand is mild enough to make a deciduous habit less profitable for a plant than an evergreen habit. After detailed field work and an extensive survey of the literature, the conclusions were that although the mild winters make deciduousness rare here, it is the relatively poor nutrient content and structure of New Zealand soils that primarily limits the abundance of those species that are deciduous. In other words, on nutrient-rich soils in a winter-cold area, deciduous species can be dominant, but once soil fertility falls, evergreen forest tends to take over.

The research was funded by the Marsden Fund, administered by the Royal Society of New Zealand, plus a Lincoln University Doctoral Scholarship to Roger Dungan, the Ph.D. student who worked on the project. The paper is directed towards a primarily New Zealand audience, and Dr McGlone preferred to publish in a New Zealand-based journal in order to focus on the issues that are most important to the New Zealand debate and thus contribute directly to developing a better understanding of our biology. NZJB provided adequate space for this, and is accessible to all who are interested and involved in the New Zealand situation. A popular summary of the project is provided in Marsden Update 28: 1–2 (July 2004).

Example 2: New Zealand Journal of Zoology

The New Zealand Journal of Zoology published a Special Issue to mark the 3rd International Wildlife Management Congress in Christchurch, in December 2003.

The holding of this important congress in New Zealand offered a large group of scientists from overseas the chance to see at first hand the range of unique problems in wildlife management we have in this country, and, even more important, some of the innovative solutions we are developing to deal with them. At the same time, New Zealand authors had an unprecedented opportunity to bring their work to the attention of a wide international audience, and conversely, to learn from overseas experience. This special issue was therefore designed to facilitate that two-way communication, and to inform and stimulate the thinking of the conference delegates about the management of invasive mammals in New Zealand and overseas.

The six reviews in this special issue were all individually invited by the Editor, and were arranged into three sections. The first covered the very large questions of strategy and ethics as applied to management of introduced mammals in New Zealand. Complex legal, scientific, organisational and social issues arise when 25 different mammalian species have to be managed by several interacting Government agencies and NGOs operating under a cumulative and changeable system of legislation. Ethicists are also challenging our traditional assumptions about hunting, and the extent to which philosophical ideas about ethics and animal welfare apply to it and, by implication, to animal control generally.

The second and third sections offered detailed accounts of case studies in management of one particular class of introduced mammals, the small mustelid and rodent predators. The authors described the problems faced by managers dealing with some key introduced predators in New Zealand (especially rats, cats and stoats), and a comparable species in UK, the American mink. Mink have invaded large areas of Britain and Europe but, fortunately, not New Zealand. We do, however, have another widespread introduced mustelid of similar size, shape and generalist tastes in native fauna, the feral domestic ferret. European and New Zealand conservation managers therefore face similar problems, but in very different circumstances.

A striking colour flyer was included in the satchels of all 800 conference delegates, and 200 copies of a specially extended print run were dispatched to Christchurch in good time. The Editor of NZ Journal of Zoology attended the congress and sold most of them during the week.

PROGRESS AND ACHIEVEMENTS EVALUATION

This year our evaluation has focused on reporting the impacts of the publications on New Zealand and on their research fields, as well as on management/process issues and new initiatives with the journals.

The New Zealand journals play a continuing and vital role in the dissemination of New Zealand research, and the national journals published by the Royal Society constitute a significant proportion of all New Zealand authored papers that are published worldwide. The Impact Factors of the journals are a measure of the journal citations and therefore how frequently the information contained in the journals is used. Papers published in the New Zealand journals have a consistent cited half-life of more that 10 years, which means that they remain relevant and useful publications for a long time following publication.

The New Zealand journals also show strong rankings in relation to other international journals in their respective fields, a measure of their relevance compared with the others.

LIBRARIANS' SURVEY

Because institutional libraries around the world constitute the largest subscriber base for the journals, and they have been decreasing progressively for more than a decade due to library budget cuts, it was thought appropriate to question their specific needs and wants of a major science publisher. Such a survey was carried out specifically on New Zealand libraries, based on a similar survey carried out from the University of Pittsburgh, USA. The responses of both surveys were remarkably similar, which is somewhat surprising because one might expect the regional content of New Zealand journals to be more favourably scored by the New Zealand librarians. Instead, the New Zealand journals appear to be regarded on an equal footing with other journals purchased from overseas, and are therefore just as at risk from being discontinued because of library budgets as any other journal from overseas.

The main findings of the survey are:

- the trend towards digital access of journal information is rated as the highest technological trend in journal publishing;
- the high cost of journals is the biggest problem faced by libraries and the main issue that needs to be addressed;
- 80% of librarians consider there is an ongoing role for print journals and that the journal, as an entity, will still be relevant in 10 years' time; there is a concern about the archival requirements of digital material and its authentication;
- scholarly societies are regarded as the most suitable organisation for the repository of digital information;
- virtual online journals are the best use of digital technology in science publishing; and
- the best opportunities for librarians and publishers to partner are in cost containment and use of Open Access.

NEW SOCIAL SCIENCES JOURNAL

This new online-only journal is required to be established during the year, in response to calls from the Social Science community and the Social Sciences Committee of the Royal Society of New Zealand, and supported by MoRST. The new journal will publish papers from a range of disciplines, unlike most other social science journals within New Zealand which have a more specialised focus. It will be of interest to researchers and teachers in tertiary institutes and research organisations both within New Zealand and overseas.

The recent increased funding from MoRST will allow the addition of extra staff for Publishing. One of their responsibilities will be to work with the Social Sciences committee to put in place the Editorial board, submission, review and production processes for the journal. This person should be employed by February and it is expected that this journal will be established, i.e. accepting and assessing papers for publication, by the end of June 2005. The first issue will be published six to twelve months after that date.

Of particular interest to the Society will be the performance and effect of such a new journal, which does not have a history of print format. It will not be easy to meet the costs of a new Social Science journal from a subscription base. Therefore, with respect to Open Access publishing, we are interested in what lessons might also be learned for the other journals published by the Society, which have long print histories and established subscription bases. Some questions to be addressed are:

- Will there be sufficient support from authors for this new journal? (For example, what is the submission rate over time, and what is the pattern of growth?)
- Where will the authorship of this online-only journal come from – within New Zealand or from outside? Do the countries of authorship reflect enhanced access by them to the journal because of Open Access?
- What will be a viable, workable business model? What is the right level of publication charge for authors?
- What is the best sustainable funding mechanism for this journal?
- What particular marketing/promotion questions need to be considered? How is the new journal to be launched on the internet?
- Will the editorial system, expected to driven from within academia on a partially voluntary basis, be a workable and sustainable one?
- What is a real measure of the journal's success under Open Access?

PUBLICATIONS AND SUBMISSIONS

The journals continue to publish a significant proportion of all New Zealand papers published. In 2003, 460 papers were submitted (the last 5 year average is 427), and 322 were published over 4231 pages (5 year averages 326 and 3980, respectively). More papers than average were submitted, and also the size of papers published has slightly increased.

It is interesting to note that 2003 was the first year in which all submitted accepted papers were liable to pay a page charge upon publication. Despite the voiced opposition to page charges at the time they were announced, this has not led to a reduction in the number of papers being submitted. Of the papers published in 2003 that were actually liable to pay, 70% did, and waivers were given to the remaining 30% whose research was unfunded. This reinforces the concept that research funds should include the cost of publication is a viable one.

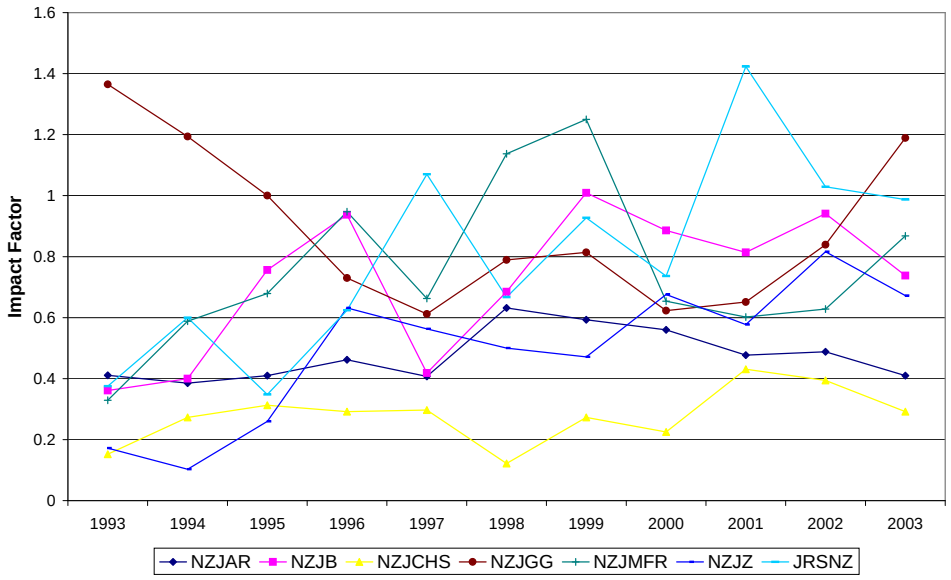
SUBSCRIPTIONS

After a year of online publishing and the imposition of page charges, the following trends are observed:

- Before 2003, the New Zealand market was predominantly of individual subscriptions.
- With the 'free' availability of the online journals now a reality, individual subscriptions are continuing to show sharp declines (of 17% in 2003 and a further 23% to July 2004). This is not unexpected and demonstrates the benefits that Open Access brings to the journal users. For the publisher, however, problems of adequate revenue from publication charges and the reimbursement of revenue lost through page charge waivers, must be addressed for the new business model to be beneficial.
- The above pattern is not repeated with overseas subscribers (mainly institutional libraries), whose criteria for subscribing are particularly cost driven rather than benefit driven. The journal price increases for 2003 have contributed to the 5% decrease in overseas subscriptions, continuing the pattern of the previous years.
- Overseas decreases in subscriptions have been well compensated for with increases in revenue received.
- The effects of the add-on benefits of online access, such as increased citations, have yet to be realised (they require a 2 year measure to assess).

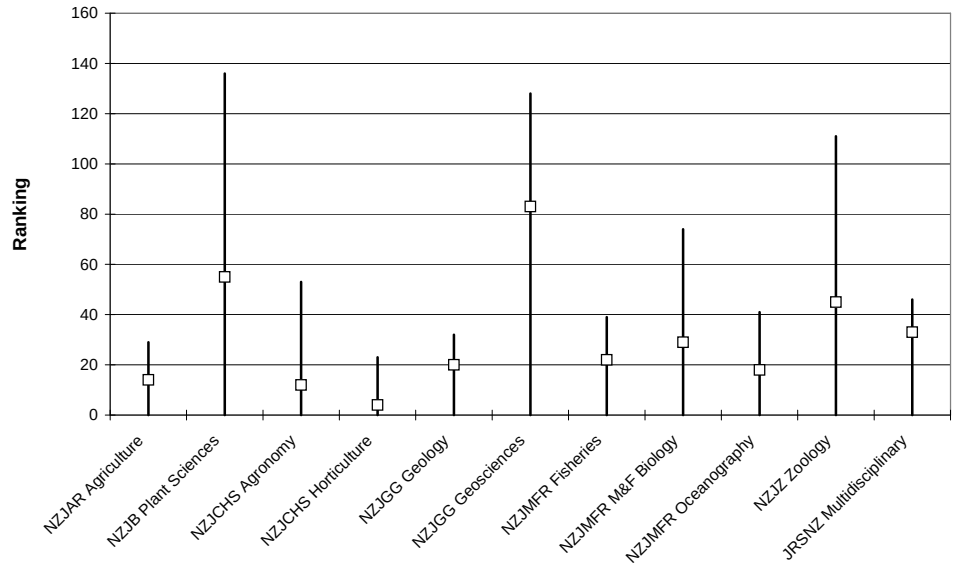
JOURNAL IMPACT

Figure 26. **Journal impact factors**



The overall 10-year trend for all journals is an increase of approximately +0.2 in impact factor. This is an encouraging indicator of the continuing relevance of the journals, especially during a decade of decreasing library subscriptions and an increase of journal titles internationally.

Figure 27. Journal ranking chart



When ranked against other journals in similar fields (from the Journal Citation Index, 2003), the New Zealand journals show uneven results. The New Zealand Journal of Crop and Horticultural Science ranks consistently low against its international competitors, whereas the New Zealand Journal of Geology and Geophysics ranks high in both its fields of discipline. The Fisheries category of the New Zealand Journal of Marine and Freshwater Research is high; however, the rankings of the other journals are in the median position. Interestingly, the Society's own Multidisciplinary journal, the Journal of the Royal Society of New Zealand, is the highest ranking of all the journals that the Society publishes.

GLOBAL CONNECTEDNESS

There is an increasing trend noticeable in some journals (NZJAR, NZJCHS in particular) over the last couple of years to receive submissions from countries, such as Turkey, China, and India, who have submitted very few papers in the past. A small number of these papers meet the requirements and scope of the journal and have been published. Many require additional editorial attention to improve the standard of English but are otherwise acceptable from a scientific viewpoint. One explanation for the increase in these submissions would appear to be the extra exposure of the journals on the internet; this highlights the effectiveness that online publishing can achieve in making New Zealand work internationally accessible and in improving the transfer of knowledge between countries. Our journal articles are now freely available in digital format two years after initial publication, and we are actively digitizing our archival issues for Open Access. This will be beneficial for all researchers, particularly those in developing and transitional countries.

ELECTRONIC PUBLISHING

The first two years of electronic publishing (2002-03) indicated that there were a growing number of 'hits' on the publishing website over that time (total hits in 2002 were 918,489; for 9 months of 2003 they were 1,654,397). (These 'hits' are a coarse measure of electronic accesses made to individual pages). A new accurate measure of file 'visits' by users was introduced in March 2004. These indicate a total of 31,135 visits to publishing pages were made in the 6 months to mid-August. Valid comparisons for future trends in usage must await the statistics to become available over the coming year.

DIGITAL ARCHIVES FOR BACK ISSUES

The recent move to electronic publication allows for the ongoing production of digital archives for new material. In line with international trends in online publishing, we are making the ongoing contents of our journal back issues available in digital, searchable format (PDF) and all online journals freely available after two years of publication. However, the Society holds archives on paper for New Zealand journals from 2002

back to 1869. These archives represent a scientific resource that the New Zealand Government has already paid for, but it will be increasingly underutilised as the research world shifts to electronic searching and handling of documents. To gain the maximum benefit from this resource, the Society would like to digitise and make available electronic copies of at least the most recent and still relevant materials.

We have obtained external funding through the DoC Terrestrial and Freshwater Biodiversity Information System (TFBIS) Programme to assist in converting our publications back to 1994 for four of the journals, and we will fund the conversion of the remaining three journals internally. Costs are minimised by the use of student labour and in-house scanning and data conversion procedures. The project is running smoothly and within budget, and the project may be extended back as our resources allow.

Making available these archives is a cost-effective way of greatly increasing the visibility and usability of the research base from which New Zealand's scientific reputation has been gained. The archives of back issues are easily searchable and this fact alone makes it more likely that value will continue to be gained from research that the New Zealand Government has already contributed towards. This is an extra activity for the Publications unit, aside from the normal business of publishing ongoing journals. Increased governmental funding will enable this programme to continue.

NON-JOURNAL PUBLISHING

The Society publishes additional books and bulletins on an occasional basis, which are usually fully funded projects arising from relevant conference proceedings or discussion documents. No MoRST funds are used directly in these publications. However, the activity constitutes an important extension to the work of the Publishing unit and adds credibility to its name as a major publisher of relevant New Zealand science. Many specialist proceedings are published in the form of journal Special Issues of the national journals, thereby adding value to the journal product and enabling the information to be disseminated to an already existing, interested market.

STRATEGIC DIRECTION AND POLICY RECOMMENDATIONS

The Society's Strategic Plan has highlighted the need to examine the relevance of journal titles and also grow in the area of non-journal publication (e.g. a Society magazine, science books). With adequate funding, the Society will continue to develop in areas of Open Access publishing beyond the present journal titles now being published. For example, a new initiative during 2004/05 will be the establishment of a new online-only journal of Social Sciences, as proposed by the Social Science Committee and supported by MoRST. Lessons learned in establishing this journal will be applied, where relevant, to new and existing journals or other publications. Ideally, a new Business Development position would provide the dedicated research and editing resources required to achieve this. Such a position could usefully evaluate new and current production methods, particularly with respect to online publishing developments for all the journals.

As mentioned, the Society has a policy of Open Access for all its publications, to allow global and free access to the work of New Zealand researchers and work relevant to New Zealand. The science journals will still be available on a subscription basis, primarily to cover the cost of their assessment, editing and printing, but the electronic version of the journals will become freely available after two years of their year of publication. Currently, the present paid subscription provides free use of the electronic version for an unlimited number of users from any one site. This is regarded as an invaluable means of disseminating the knowledge contained in the journals to the widest possible audience who have an interest and concern in that information. It also makes information accessible to those who would otherwise be unable to afford it.

In 2003/04, approximately one-third of journal costs were met by Government funds, the remainder coming from nominal author page charges and the subscriptions themselves. There is a large section of authors (including students, retired scientists, and scientists from developing countries) who have no research funding or personal funds available to cover the publication charges, and these costs are currently covered by Society page charge waivers. These researchers are producing work at low cost and the Society's page charge waivers enable this cost-effective research to reach its intended audience. Future Government funding is sought to cover the cost of these waivers, which can constitute up to 30% of page charges due.

In summary, by providing sufficient funding to cover the full publication costs of the journals, the Government will not only assist all New Zealand researchers to publish their work effectively, but also make research which is relevant to New Zealand more widely available.

ALPHA AND GAMMA SERIES OVERVIEW

ALPHA SERIES

The Alpha series is a set of resources, primarily designed to support the learning of science, mathematics and technology in schools and the wider community. They are strongly linked to the NZ Curriculum, offer career information, and are issued with teacher notes and student activities. They are produced for students ranging from senior primary to senior secondary levels. Practising scientists and educators collaborate to write about topics that are chosen through consultation.

Issues are made available for a nominal cost, through libraries and retail outlets such as Science Centres. Some sponsoring (research) organisations have used the Alpha as part of their public awareness obligation by providing text and expertise. Alphas are now available freely on line – and the printed, glossy, full colour presentation is as popular as ever, as sales do not appear to have decreased since open access online.

http://www.rsnz.org/education/alpha/

GAMMA SERIES

The Gamma series is 'the science behind the news', presented in shorter form than Alphas, and in black-and-white. Each is produced on a fast-track timetable, to provide information for topical issues. They provide a balanced and factual account about the issues and additionally support science and technology teaching in the school curriculum. Some libraries and schools subscribe to the Gamma Series and particular issues are made available to journalists and members of Parliament. The Gamma series is now freely available on the website, and subscriptions have decreased dramatically in the last two years.

http://www.rsnz.org/education/gamma/

PROGRESS AND ACHIEVEMENTS EVALUATION

Four issues of Alpha and five of Gamma were produced in 2003/04

ALPHA SERIES

Alpha 118 'Hydrogen – fuel cells – energy' was written by Louise Thomas of Wellington, and looks at the research and development of hydrogen as a vehicle fuel, how this could be done, and outlines reasons to move away from a fossil-fuel economy.

Alpha 119 'Insect invaders and the seduction of scent' was written by Louise Thomas, Wellington with input from Dr M Suckling, HortResearch. It includes the history of insect invaders to NZ and the development of pheromones as a method of control. There is particular reference to the Painted Apple Moth campaign and the critical need to protect our environment.

Alpha 120 'Unlocking the ice house – Antarctica and its role in climate change' was written by Dr Tim Naish, GNS – who also sponsored the resource with Antarctica New Zealand. It details indicators for climate change from research in the Antarctic.

Alpha 121 'Michael Walker – Te Putaiao me te Moana' (note that this title was printed in the 2004/05 year) and Alpha 122 'Michael Walker Scientist and the Sea', written by Lynley Hargreaves, feature the role model, Professor Michael Walker, (University of Auckland). They describe his early days, including schooling, his career to date, and his research in the areas of animal navigation and magnetism, as well as his work in setting up the Tuakana (elder sibling) programme.

The series of Alphas is a valuable resource, and they have a long shelf life. Between August 2003 until March 2004 (incl.) approximately 40% of sales were for titles numbered 1 – 50, 25% for titles 51 –100 and 35% for titles from 101-120. Titles 1 to 50 were published prior to 1985, while 51 –100 were printed from 1986 to 1999.

A number of older titles are now in urgent need of rewriting and updating e.g. Birds at risk, Drugs in sport, Biotechnology, Forensic Science, Food additives and others. It is estimated that revision of 5 titles per year, would cost the equivalent of the present budget for new titles.

> *"Alphas are a wonderful resource – and the teacher notes and student activities are just ideal for class use"*
>
> Rex Bartholomew, Wellington College of Education

GAMMA SERIES

The titles in 2003-2004 were topical and received widespread interest, they were:

- Life after Dolly
- Malaria
- Biological weapons – spreading fear
- Dangerous chickens- the (Asian) bird flu epidemic
- The business of drinking water

> *"There's now a great range of Gamma topics – always seems to be one you can use to complement class work in science or current events."*
>
> Les Black, Riccarton High School

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

Both series provide a valuable public information service – at times titles have been requested by public libraries or provided to politicians, Government agencies or other organisations including newpaper reporters.

Plans for 2005 include the production of a further dual Alpha in Te Reo Māori and English. The recent pilot of this idea, which was delayed while sponsorship for the translation was sought, proved that such a resource would fill a gap in the S&T publications in Te Reo. Moreover they feature inspirational Māori role models, which may improve the responsiveness of Māori to S&T in schools. The 'extra' edition in Māori, a first for the RSNZ, has involved extra time and effort and costs in translations, editing, layout and design. With sponsorship it is hoped to be able to distribute multiple copies freely to many learning institutions including Kura Kaupapa and other schools seeking S&T resources in Te Reo Māori.

Plans for 2005, funding being available, include a similar dual production featuring notable scientists (e.g. Rutherford and Pickering), or on environmental issues of kaitiaki/tikanga e.g. stream care.

INTERNATIONAL

As the major funder of research in New Zealand the Government has a substantial responsibility for international collaboration. The Royal Society is a part of this responsibility. The Society makes a significant contribution to this by way of its increasing participation in global connectedness through the management of the International Science and Technology (ISAT) Linkages Fund, and the International Conference Fund; the memberships of 32 international scientific unions and their associated committees; the liaison and dissemination of S&T information and opportunities from the Ministry of RS&T's NZ Counsellor in Brussels; the Society's own Memoranda of Understanding with various international organisations, and its involvement with the Wellington-based Embassies.

Tangible benefits accrue to New Zealand from its international links in RS&T and these links allow New Zealand to contribute to, and draw from, the global effort. We must continue to develop and maintain excellent, focused and active links with other countries. Global economic, technological, social and environmental changes will continue to affect the way New Zealand interacts with the rest of the world and in its continuing role in RS&T.

INTERNATIONAL SCIENCE AND TECHNOLOGY (ISAT) LINKAGES FUND
OVERVIEW

The ISAT Linkages Fund is a part of the overall International Linkages component of the Ministry of RS&T whose mission is to foster stronger global connectedness between New Zealand researchers and the rest of the World.

International links are unanimously viewed as being important because they enable NZ researchers and research organisations to:

- gain access to, and share information, resources, technologies, methodologies and techniques; and
- operate more effectively in a global research market, maintaining competitiveness and international relevance.

There have been some significant changes to the ISAT Linkages Fund over the past 12 months and these include:

- a 90% increase in the size of the Fund administered by the Society;
- multi-year funding (ie funding can now be granted for up to 3 years);
- the increase in the number of preferred countries from 3 to 8; and
- applicants are now able to include conference attendance in their application provided the research project remains the substantial purpose of the collaboration.

HIGHLIGHTS

The following are 3 examples of ISAT Linkages Fund projects undertaken during 2003-04.

Development of technology for commercial cultivation of marine algae

Dr Falshaw, Industrial Research received a grant to host Dr Lynne Browne, Queen's University, Belfast, Ireland on the project "Development of technology for commercial cultivation of marine algae". This project centred around a seaweed aquaculture cultivation trial including spore collection, cleaning, culture conditions aimed at inducing spore attachment and growth, and suitable strategies for minimising the growth of contaminants. Figure 28 shows some of the substrates used in this research. Early success in establishing hatchery techniques for seaweed will provide the impetus for the development of an industry that is estimated to be worth $5 million to $8 million to New Zealand in overseas earnings and will allow the institution to clearly signal to funding agencies the areas of further research that will be needed to commercialise seaweed farming technology. During her visit to New Zealand Dr Browne was interviewed by the Dominion-Post resulting in an article being featured on 2 April 2004.

Figure 28. **Experimental substrates used in the cultivation of marine algae**

Determining the impact of atmospheric chemistry during the transport of methane and carbon dioxide from the northern hemisphere to New Zealand and the south west Pacific

One of the aims of the Fund is to endeavour to access mainstream funding and Dr David Lowe, NIWA received an ISAT grant to collaborate with Dr James White, University of Colorado, USA on a joint research project titled "Determining the impact of atmospheric chemistry during the transport of methane and carbon dioxide from the northern hemisphere to New Zealand and the south west Pacific". The collaboration was very successful and during Dr Lowe's visit to Colorado he secured a grant of $USD 50,000 from the National Oceanic and Atmospheric Administration for a project involving the use of Japanese vehicle carrier ships that travel between Japan and New Zealand as a platform to collect large clean air samples. On this route the ships pass through meteorological convergence zones near the equator which separate the two hemispheres and slow down the movement of pollutants from the northern to the southern atmosphere.

Mobile Collaborative Augmented Reality Environment

A further demonstration of accessing mainstream funding is highlighted by Dr Mark Billinghurst, University of Canterbury. Dr Billinghurst received an ISAT grant to host Dr Reiner Wichert, Zentrum für Graphische Datenverarbeitung e.V (Computer Graphics Center), Germany on the project "Mobile

Collaborative Augmented Reality Environment" and this collaboration has resulted in a successful bid from the Australiasian Centre for Interaction Design (ACID) research consortium. It is anticipated that applications for future funding will also be possible.

PROGRESS AND ACHIEVEMENTS EVALUATION

The Fund is contestable and funding is keenly sought by the NZ research community. Applications to the Fund are called for twice yearly with a selection panel of 6 eminent researchers evaluating the applications and recommending those for funding.

In the year to 30 June 2004 the Society received 165 applications from New Zealand researchers wishing to collaborate with international researchers through the Fund. 116 (70%) applications were successful in obtaining funds with 32 (28%) applicants receiving multi-year funding. Twenty-four different countries were involved.

The following two graphs distinguish the trends in size and value of the grants over the past 5 years (please note that the Fund was significantly increased in 2003-04).

Figure 29. **Value of grants awarded by the ISAT Linkage Fund**

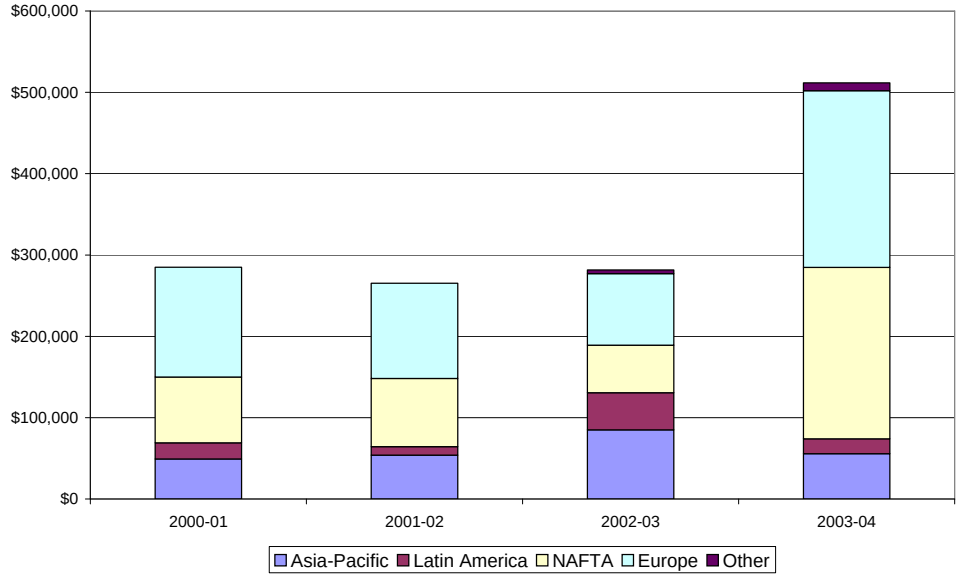
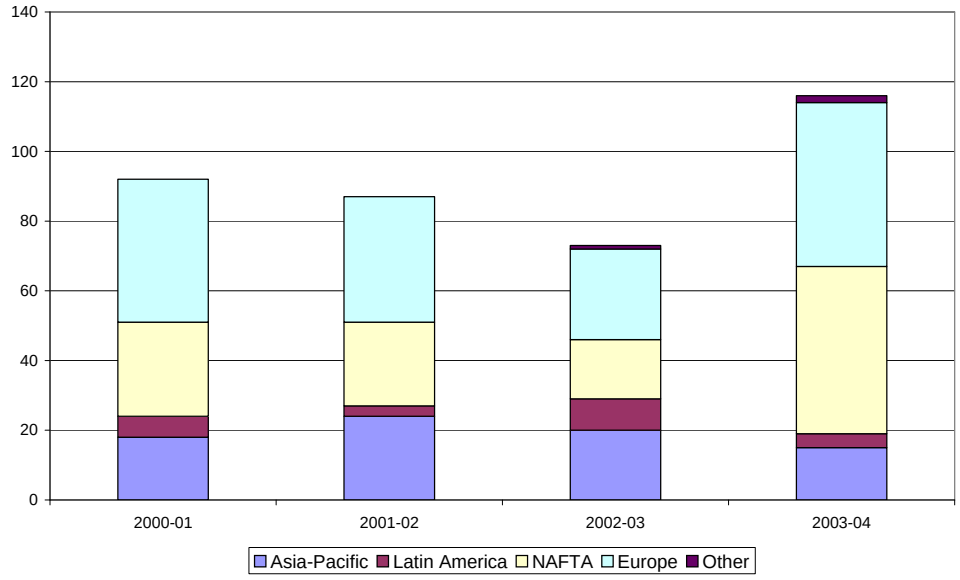
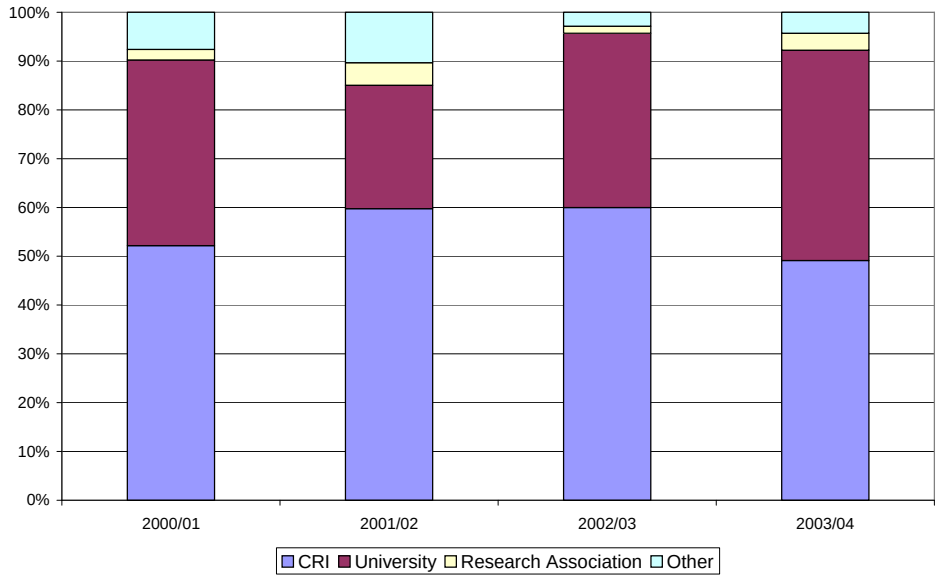


Figure 30. **Number of grants awarded by the ISAT Linkage Fund**



Access to the Fund is shown in Figure 31. CRIs appear to make better use of the Fund than universities. The private sector is very limited in its use of the funds. It is not known why this is the case. The private sector is allowed to access the Fund. However, the Fund is not publicized outside the usual scientific networks, nor has provision been made within the output class for more general publicity

Figure 31. Type of institutions that participate in the ISAT Linkage Fund



For the relatively small amount of investment the Fund has many benefits to New Zealand and these include:

- workshops held for other NZ researchers when the overseas researcher is hosted in NZ;
- contribution to the recognition that NZ is a centre of innovation by showcasing our scientific abilities and attributes;
- access to international knowledge, and state-of-the-art equipment; and
- published work.

Several directly measurable indicators are tracked yearly. The next figures clearly demonstrate the high outputs from the awards, and the impact the awards have on further funding opportunities.

Figure 32. Outputs from the ISAT Linkages Fund

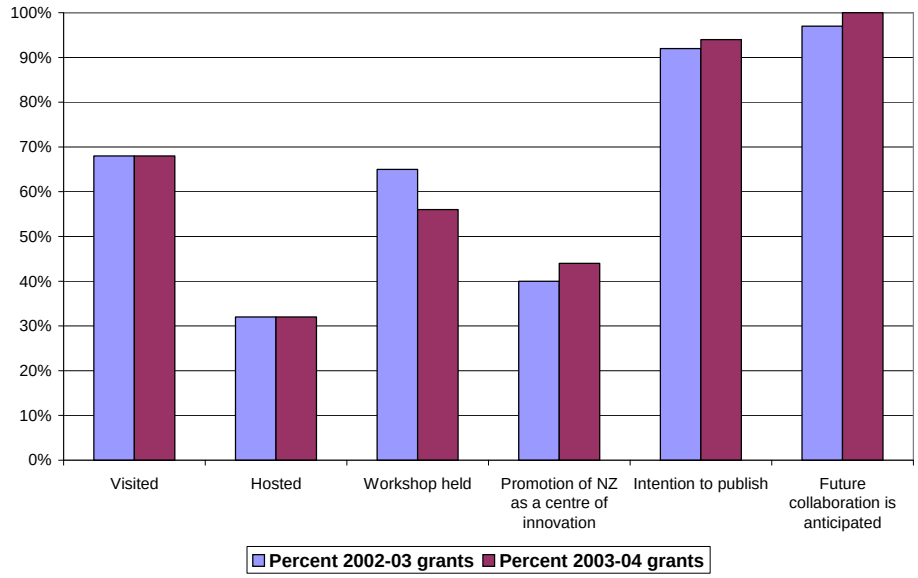
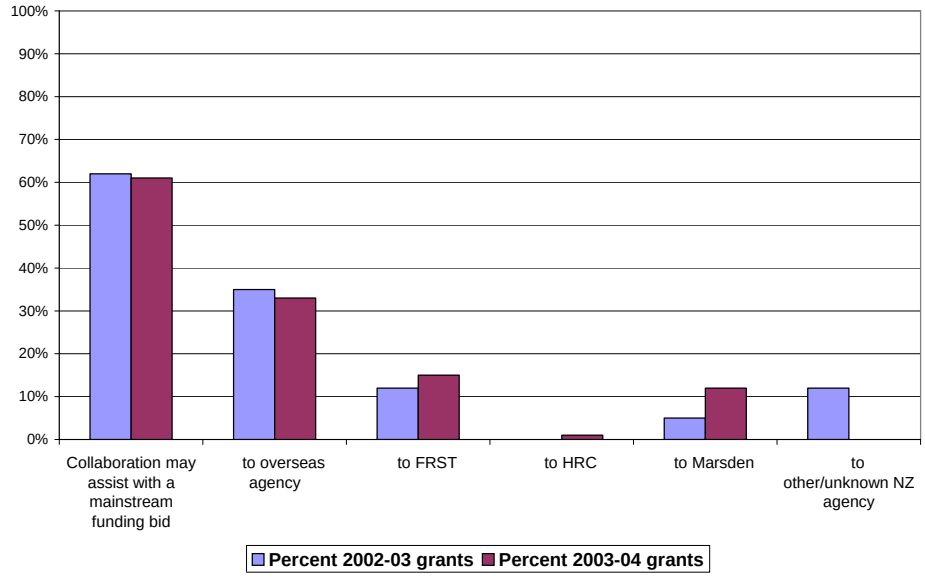


Figure 33. Impacts of projects funded by the ISAT Linkages Fund



An evaluation of the Society's component of the Fund is to be carried out commencing in November 2004. The evaluation will gather evidence such as how much of the investment has resulted in ongoing collaboration; barriers faced by recipients of grants; investments obtained from other instruments; and outcomes related to publications, patents, equipment and/or databases developed etc.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

When NZ researchers have the chance to collaborate with overseas researchers then those collaborations can be very fruitful. Those links are so successful because of the ongoing collaborations developed; the investments obtained from other instruments both in NZ and overseas; the refereed papers contributing to NZ's knowledge base; and the exposure of the international community to NZ's many areas of research. The ISAT Fund achieves these benefits at very low cost. Two of the highlights showed that small ISAT grants have lead to obtaining foreign investments of ten times the size of the ISAT grant.

The ISAT Linkages Fund was reviewed by MoRST in 2002. The review recognized the Fund as extremely successful. The component of the Fund administered by the Society was increased with the requirements of the Fund changing to allow grants to be made for up to 3 years.

However, this change causes knock-on effects for the management of the Fund. The change of Fund size combined with an increase in commitment in the out-years results in a bounce effect on the funding available for future years. For example, if the status quo remains then, because of ongoing commitments, the new funding available for 2005-06 will be greatly reduced; and that available for 2006-07 will be further limited. In 2008-09 it is anticipated that no new funding will be available.

The Royal Society has been instructed by the Ministry not to withhold any significant funds in a particular year. With this instruction, the Royal Society cannot avoid or alleviate these knock-on effects by phasing in funding increases. All of the increased funding has been awarded or committed, as instructed, and problems will arise for the fund in the near future. To alleviate this potential problem, either the Fund receives an annual increase, or alternatively, the Society be permitted to retain 15% of the year's allocation for the following years.

OTHER INTERNATIONAL ACTIVITIES OVERVIEW

The Royal Society undertakes numerous activities to support New Zealand's international research links. Our role in this area has expanded considerably in recent years, with membership of the scientific unions, international travel grants, and distributing information about international funding opportunities through the CoLab information clearinghouse, as well as the development of Memoranda of Understanding for closer links with selected countries.

The Royal Society also manages the International Conference Fund for MoRST. This Fund allows the awarding of funding to organisations to assist with holding international conferences within New Zealand and thereby helping to promote New Zealand as a centre of innovation, to assist New Zealand researchers in developing relationships with reputable international researchers, and to assist with developing future international opportunities and utilising advances in RS&T for economic, social and/or environmental progress.

HIGHLIGHTS

Funding provided in 2003-04 was able to:

- fund 10 international conferences to be held in New Zealand;
- adhere to 32 scientific unions or associates;
- provide partial funding to 9 delegates to attend their respective general assembly; and
- create a website that offers European information and opportunities to the New Zealand research community.

The funding to the Australia-New Zealand Forensic Science Conference was a significant event. This conference, opened by the Governor-General, was held at Te Papa, Wellington in March-April 2004 and attracted 290 forensic science practitioners, managers, and supporters from Australia, Canada, China, Germany, Malaysia, Russia, Singapore, Switzerland, United Arab Emirates, United Kingdom, and United States of America. 128 New Zealanders were also in attendance.

Another highlight was the provision of funding to the 8th International Global Atmospheric Chemistry Conference to be held in Christchurch during September 2004. The conference has attracted 450 registrations including some of the highest profile scientists in atmospheric chemistry in the world. This will not only benefit the New Zealand science community, but is expected to impact the New Zealand economy by some $4 million.

At present nine New Zealanders hold senior positions on international unions, scientific associations or commissions, as described in AppendixVII.

PROGRESS AND ACHIEVEMENTS EVALUATION

All international activities of the Society have an input into the overall global connectedness, not only of MoRST, but of the whole of the New Zealand science community. International links are viewed as extremely important as they enable New Zealand to gain access to, and to 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; to operate more effectively in a global research market, to maintaining competitiveness and international relevance; and to maintain and improve institutional international reputations through participation in global bench marking/quality control programmes and international conferences.

INTERNATIONAL CONFERENCE FUND

The Fund requires that at least 8 conferences will receive financial support in any one year. For 2003-04 10 international conferences (listed below) to be held in New Zealand were funded. Although some of the conferences are yet to be held it is anticipated that there will be at least 33% of overseas registrations.

- 19th Congress of the International Society of Biomechanics
- Evaluation: Who Benefits?
- 2003 Australasian Research Management Conference
- Remarkable Delta '03
- Victoria International Conference in Mathematics
- 17th International Symposium on the Forensic Sciences
- 33rd Annual Meeting of the Society of Australasian Social Psychologists
- 8th International Global Atmospheric Chemistry Conference
- 5th International Conference on Priorities in Health Care
- 8th International Conference "Developments in Language Theory"

INTERNATIONAL UNION MEMBERSHIP

On behalf of Government the Society adhered to 32 scientific unions or associates. The full list can be found in Appendix VII.

NZ Delegates

The following 9 delegates received partial funding to attend their respective general assembly:

- 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 Kip Powell, University of Canterbury for attendance at the International Union of Pure and Applied Chemistry Council meeting in Ottawa, Canada, August 2003;
- Dr Sally Jo Cunningham, University of Waikato for attendance at the APEC Training for Women's IT Capacity Building Programme in South Korea, August-September 2003;
- Dr Bill Jordan, Victoria University for attendance at the International Union of Biochemistry and Molecular Biology XIX General Assembly in Montreal, Canada, October 2003;
- Dr Mary McIntyre, Victoria University for attendance at the International Union of Biological Sciences XXVIII General Assembly in Cairo, Egypt, January 2004; and

- Professor John Buckeridge, Auckland University of Technology for attendance at the International Union of Biological Sciences XXVIII General Assembly in Cairo, Egypt, January 2004.

MEMORANDA OF UNDERSTANDING

The Society has its own Memoranda of Understanding with the following 4 organisations:

- Beijing Association for Science and Technology (BAST);
- Shanghai Association for Science and Technology (SAST);
- Korea Association of Science and Technology (KAST); and
- Korea Science and Engineering Foundation (KOSEF).

These memoranda promote scientific cooperation between the parties for scientists to facilitate the exchange of scientific knowledge and experience, particularly in the final stage of planning; support bilateral seminars, colloquia and symposia of high scientific standard; undertake joint research projects resulting from earlier contacts and/or planning activities; and exchange scientific information, publications, samples, specimens and other material.

Examples of support under these memoranda arranged with the Royal Society's assistance are:

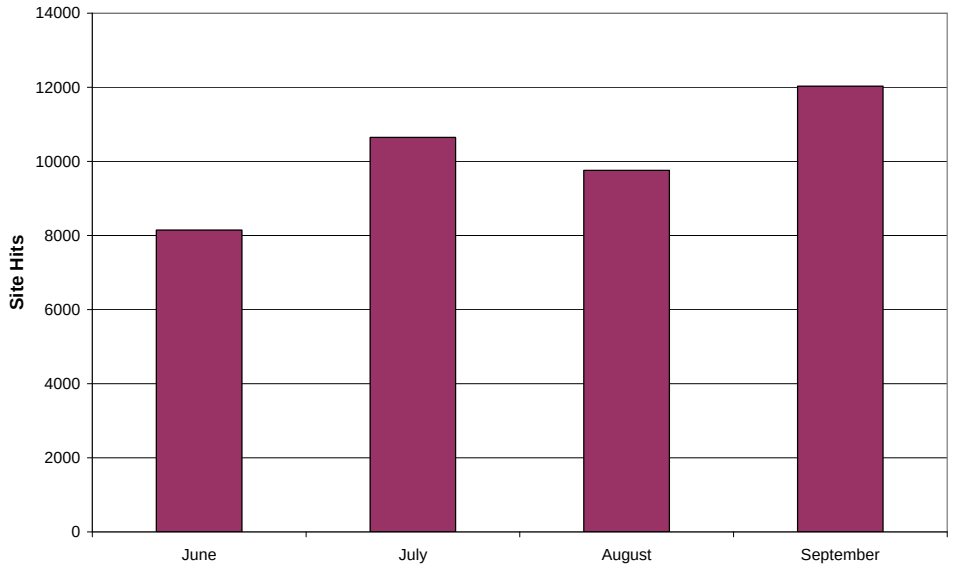
- Ms Jiansi Yang of the Institute of Geophysics, Beijing, China attended the 2003 Western Pacific Geophysics Meeting (WPGM) held at the Wellington Convention Centre, Wellington, during 9-12 July 2003.
- Professor Hwa Hyoung Lee and Professor Ho-Yang Kang of the Chungnam National University along with Professor Kyu Hyeok Kim, Korea University, Professor Yoon Soo Kim, Chonnam National University, Professor Won Hee Lee, Kyungpook National University, Professor Jun-Jae Lee, Seoul National University, and Professor Su-Kyoung Chun, Kangwon National University, Korea visited Dr Bryan Walford, NZ Forest Research Institute, Rotorua, New Zealand during 20-24 July 2004 to participate in the NZ/Korea Seminar on Wood Technology and to discuss matters of mutual interest.
- Dr Myung-Haeng Hur of the Eulji University, Korea visited Dr Wendy Marddock-Jennings, University College of Learning, Auckland during 1–14 August 2004 to carry out research on the "Application of Aromatherapy for Clinical Nursing Field" and to discuss matters of mutual interest and the prospects of closer relationships between the two organisations.

ESTABLISHMENT OF INFORMATION CLEARINGHOUSE

In May 2004, MoRST contracted the Society to establish and maintain a website for the dissemination of information and opportunities emanating from Europe principally through the NZ Counsellor based in Brussels. This 'clearinghouse' operation has now been in place for 3 months and is being developed week-by-week. The clearinghouse has become the central focus of the dissemination of information and opportunities to the NZ scientific community with an objective to strengthen NZ-EU RS&T linkages.

A website (www.colab.rsnz.org) has been developed and was launched on 1 June 2004. The usage of the website is growing by an average of 30% per month by numbers of visitors. In terms of unique visitors, the number has grown from 342 in June to 741 in September. A 0.5 FTE person has been engaged to update the website on a daily basis. The establishment of a fortnightly electronic newsletter is to be implemented as is a list of strategic people in the various NZ scientific institutions.

Figure 34. **CoLab usage graph, hits per month**



POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

New Zealand's global connectedness and participation is necessary to discharge global responsibilities such as biosecurity; environment; biotechnology etc. The cost is expensive especially with New Zealand physically being in a remote position in contrast to Europe and the USA.

As the international work of the Society is enhanced, we need increased resources.

The CoLab clearinghouse is clearly growing in usage and will continue to be enhanced. With the impending appointment by MoRST of a NZ/USA Counsellor to be based in Washington D.C. the 'clearinghouse' operation may be further expanded to disseminate information and opportunities from North America. This may mean that the 0.5 FTE currently funded by MoRST will have to become a 1.0 FTE. Therefore, it is strongly recommended that the present funding of the clearinghouse operations be increased in 2005-06 to allow the half-time position to become full-time.

APPENDIX I

MARSDEN FUND - QUANTITATIVE INDICATORS AND QUALITATIVE ACHIEVEMENTS

BUILDING NEW ZEALAND'S KNOWLEDGE BASE

Research Productivity and Dissemination

Table 12. Publications, patents and software directly attributed to Marsden grants.*

	1994	1995	1996	1997	1998	1999	2000	2001	2002	all
Papers	24	37	96	132	247	294	365	404	434	2033
Refereed Conference Proceedings	0	2	15	27	33	41	73	66	94	351
Book Chapters	3	2	6	11	25	25	40	46	66	224
Books	0	0	1	1	2	2	3	8	9	26
Edited Volumes	0	0	0	0	2	3	2	8	10	25
Reports	0	1	5	14	13	22	11	12	8	86
Patents (full or pending)	0	0	0	0	1	3	1	3	1	9
Software	0	0	0	0	1	0	0	0	3	4
Total	27	42	123	185	322	387	494	544	625	2758

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

Table 13. Dissemination of Marsden results through conferences and other channels.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	all
Invited conference talk	0	1	15	32	44	59	77	77	92‡	397
Contributed conference talk	0	5	23	68	120	223	260	337	228‡	1264
Conference poster	9	8	43	110	163	144	94	77	71‡	719
Other†	0	1	0	6	10	9	21	22	24‡	93
Total	9	15	81	216	337	435	452	513	415‡	2473

†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.
‡ Minimum figures, as some data from 2002 is outstanding.

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 2003-04 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 78% of current contracts (excluding those awarded in 2003/04) have been presented at international conferences.
- Of the 9 holders of the prestigious James Cook Research Fellowships with tenure during the 2003/04 year, 7 are principal investigators on current Marsden contracts.
- Numerous prizes and awards to Marsden researchers, as listed in Table 14.

Table 14. Prizes and awards for Marsden-funded researchers

Marsden researcher	Contract	Distinction awarded
Professor Wes Sandle	UOO608, UOO910	Officer of the New Zealand Order of Merit
Professor Margaret Brimble	UOA803, UOA118	Member of the New Zealand Order of Merit. Novartis Chemistry Lectureship. Inaugural Rosalind Franklin Lectureship, UK. Awarded James Cook Fellowship, 2003
Professor John Flenley	MAU907	Awarded DSc by Cambridge University
Professor Gaven Martin	UOA523, UOA811, UOA126, UOA520, MRI801, MRI101,	Awarded a prestigious "Research in Peace" Prize from the Royal Swedish Academy
Professor Richard Le Heron	UOA005	Elected as Fellow of the Royal Society of New Zealand, 2003. Honorary Life Membership of the NZ Geographical Society
Dr Bruce Hayward	PVT903, PVT201	Elected as Fellow of the Royal Society of New Zealand, 2003
Associate Professor Michael Walker	UOA601, UOA824, UOA111, UOA128	Elected as Fellow of the Royal Society of New Zealand, 2003
Professor Geoffrey Jameson	MAU606, MAU010, MAU205, MAU008, UOC303	Elected as Fellow of the Royal Society of New Zealand, 2003.
Professor Michael Steel	UOC516, UOC703, UOC005, UOC310, MAU602, MAU605, MAU206, VUW303	Elected as Fellow of the Royal Society of New Zealand, 2003
Dr David Wardle	LCR501, LAN603, LCR801, LCR901, LCR202	Elected as Fellow of the Royal Society of New Zealand, 2003
Dr George Davis	AGR301	Elected as Fellow of the Royal Society of New Zealand, 2003
Professor Miles Fairburn	UOC806	Elected as Fellow of the Royal Society of New Zealand, 2003
Professor Vincent O'Sullivan	VUW904	Biography of John Mulgan short listed for the 2004 Montana Book Awards. Awarded $100,000 Michael King Writers' Fellowship from Creative NZ
Professor Dame Anne Salmond	UOA815, UOA311	Book "Trial of the Cannibal Dog" short listed for the 2004 Montana Book Awards (Winner: Non-Fiction)
Professor Christine	UOO513, UOO903	University of Otago Distinguished Research

Winterbourn		Medal
Professor Richard Sibson	UOO216	University of Otago Distinguished Research Medal
Dr Kathryn McGrath	UOO817, UOO911, UOC205, VUW310	Easterfield Medal 2003 (NZ Institute of Chemistry)- awarded for significant contributions to chemistry to researchers under 35
Assoc Prof David Kelly	UOC001, UOC103,	RSNZ Cockayne Lecturer 2004
Dr Nicola Gavey	UOA006	Selected as one of 22 Fulbright New Century Scholars worldwide
Professor Rod Downey	VIC509, VUW802, VUW106, UOA520, MRI801, MRI101	NZ Mathematical Society Research Award (Maclaurin Fellowship)
Dr Rod Gover	UOA207	NZ Mathematical Society Research Award (Maclaurin Fellowship)
Professor Graham Smith	UOA516, UOA715	Te Tohu Pae Tawhiti Award for Research in M?ori Education (NZ Association of Research in Education)
Assoc Prof David Schiel	UOC306	New Zealand Marine Sciences Society Award
Professor Andy Sturman	UOC602	Inaugural Edward Kidson Medal (Meteorological Society of NZ)
Professor Robert McLachlan	MAU609, MAU202	Research Medal (NZ Association of Scientists)
Dr Cornel de Ronde	GNS702	Communicator Award (NZ Association of Scientists)
Dr Charles Semple	UOC005, UOC310	RSNZ Hamilton Memorial Prize 2003
Dr David Hutchinson	UOO102, UOO323	First recipient of the Rowheath Trust Award and Carl Smith Medal for outstanding research by an early career staff member
Assoc Prof Sally Brooker	UOO909, UOO324	Distinguished Young Chemists Award plenary lecture at the Federation of Asian Chemical Societies conference in Hanoi, Vietnam
Professor Donald Evans	UOO101	Appointed to Stem Cell Oversight Committee (Canadian Institutes of Health Research)
Dr Vickery Arcus	UOA129	2003 QMB Invitrogen Award for excellence in molecular biology
Dr Merryn Tawhai	UOA123	Maurice Paykel Postdoctoral Fellowship
Dr Daniel Jagger	Post-doc on UOA002	Awarded a Royal Society Research Fellowship in the UK
Yongjin Shang	PhD student on CRO101	PhD student Yongjin Shang awarded "Best Student Poster" prize at overseas conference
Carole Wright	PhD student on UOW002	Awarded "Best Student Paper" prize twice- at one conference in NZ and one in Australia
Richard Clare	PhD student on UOC006	Awarded "Best Paper" prize at a NZ conference, 2003
Brett Davis	Honours student on UOC107	MacDiarmid Young Scientists of the Year Award: Agriculture and Forestry and Fishing

ENHANCING GLOBAL CONNECTEDNESS

The proportion of the contracts involving principal and associate investigators from just a single institution has decreased from 77% in 1995 to 41% in 2003.

The percentage of contracts that specifically include overseas principal or associate investigators is 40% for this funding round. Further collaboration occurs during the course of the research and the percentage of current projects with international collaboration is 66%. Since 1996, the percentage of contracts with a New Zealand collaborator from outside the host institution has been steady at 20-30%, as shown in Figure 36.

The sources of the New Zealand collaborations are shown in Figure 36.

Figure 35. **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**

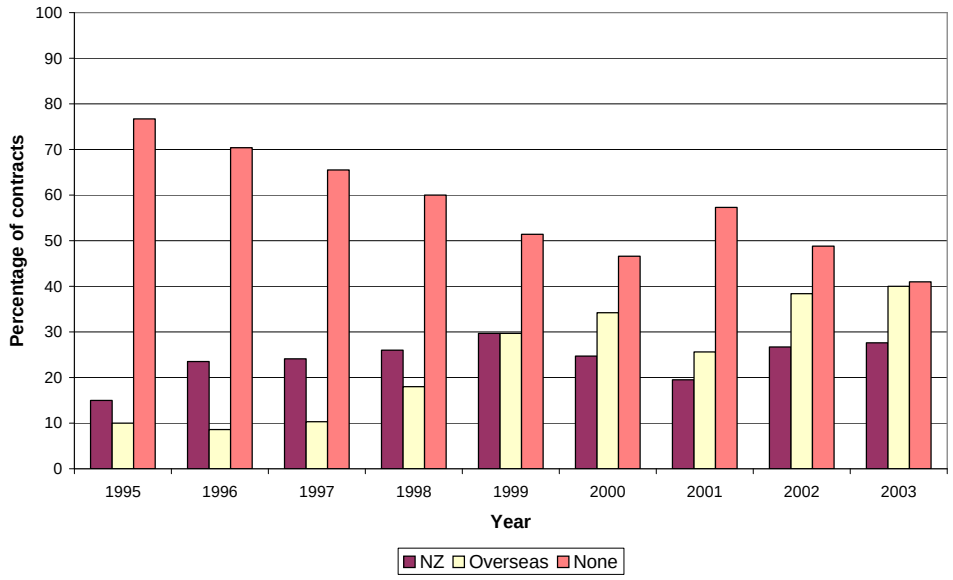
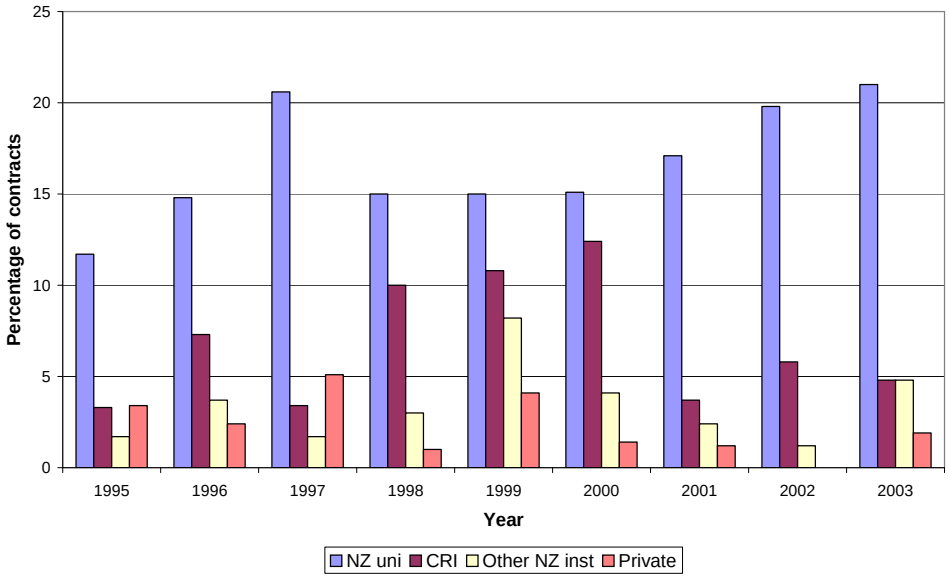


Figure 36. **The percentage of contracts for which a principal or associate investigator is in New Zealand and outside the host institution, categorised according to whether the collaborator is from a university, a CRI, any other New Zealand institute or company or Government department, or is a private 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 a synchrotron in France to measure protein dynamics and kinetics.
- The use of techniques in the USA to test antisense methods of generating elastin-enriched artery wall tissue in animals.

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

- A postdoc visiting the National Institutes of Health, in the United States, to learn microarray techniques for gene expression analysis in order to speed up the establishment of these methods in New Zealand.
- A PI spending part of her sabbatical leave at Los Alamos National Laboratories to establish a new collaboration in the area of beryllium porphyrin chemistry, one of this US lab's strengths.

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

- Dr Andrew Wilson obtained a JILA Visiting Fellowship, to work with Nobel Prize winning physicist, Carl Wieman, at the University of Colorado.

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.
- A PI convened an international symposium in Scotland on the subject of applied research in memory and cognition.
- Another PI organised an international workshop at Harvard on long distance transport processes in plants.
- One PI organised an Australasian zebrafish workshop.

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

- A graduate student from the University of Muenster in Germany spent 2 months in New Zealand contributing to research on porphyrin chemistry.

Leveraging Marsden funding with overseas funding. Examples include:

- One PI gained significant funding from the National Science Foundation in the USA for a complementary project. The NSF money has supported 2 post-docs and several students based in the USA, as well as conference travel.
- Another PI has successfully gained NSF funding, which has supported a large fieldwork programme. The same PI also gained funding from Caltech in the USA to spend five months there related to the Marsden research.
- A PI was awarded a grant from Canada, allowing her to travel there and to use Canadian data for an extra study for her Marsden project.

BUILDING HUMAN CAPACITY

Principal and Associate Investigators

The Marsden Fund has supported established researchers by:

- Funding contracts starting in the 2003/04 year that involve 141 principal investigators (all except five of whom are based in New Zealand) and 174 associate investigators (of whom 61% are based in New Zealand).
- Supporting contracts in the current year which involve 923 separate individuals as principal and/or associate investigators.

New and Emerging Researchers

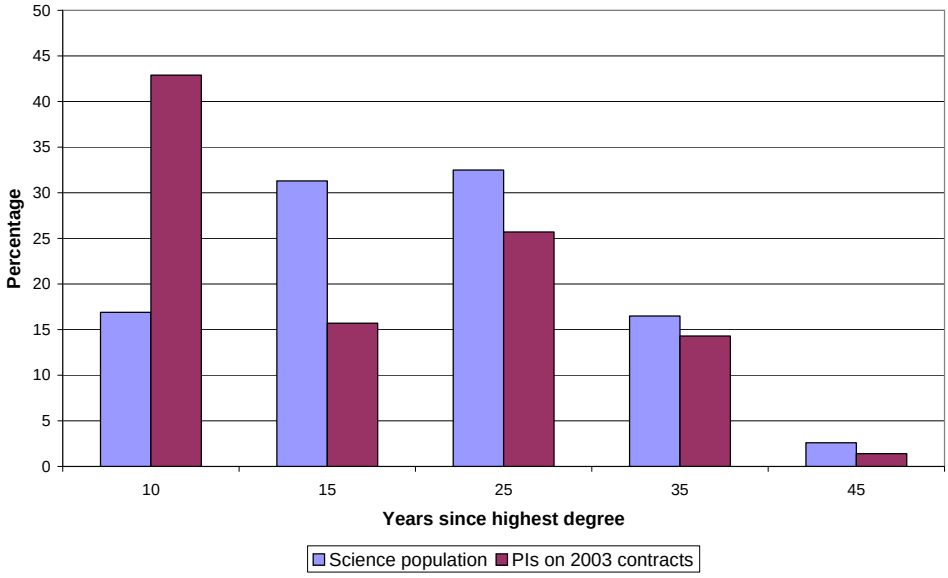
The Marsden Fund invests heavily in emerging researchers. 28 Fast-Start contracts were awarded in 2003/04, to researchers who have had no more than 7 years' research experience since completing their Ph.D.

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 658 contracts awarded between 1996 and 2003, funding has been available for postdocs in 39% of them, providing the equivalent of 213 full-time 3-year appointments. In the 2003/04 year, the first year of new contracts has supported 39 FTE postdoctoral positions.

For the 658 contracts awarded between 1996 and 2003, funding has been available for postgraduate students in 54% of them. In the 2003/04 funding round, the first year of new contracts has supported 63 FTE postgraduate positions.

In 2003/04, 43% of all principal investigators and 39% of all associate investigators are within just 10 years of completing their Ph.D. (that is, in most cases, are under 35 years of age). Last year, the corresponding figures were 38% and 27%, respectively. The participation of emerging researchers is significantly greater than would be expected from demographic considerations alone (Figure 37 and Figure 38). Three years ago, before the start of the Fast-Start scheme, 27% of all principal investigators were within 10 years of completing their Ph.D..

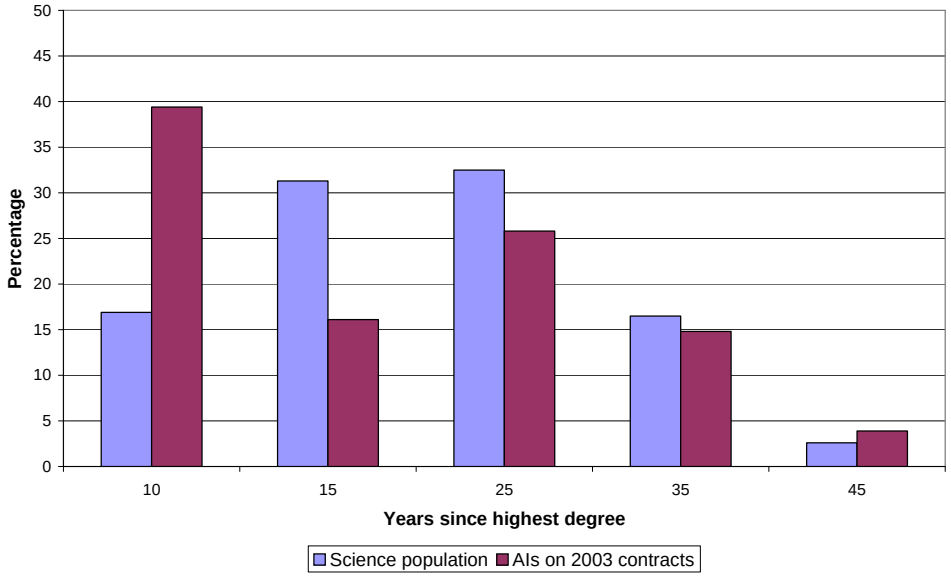
Figure 37. Experience of principal investigators (PIs) on contracts awarded in 2003/04, as measured by the number of years since the principal investigator obtained their highest degree.



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"[15]. [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.

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

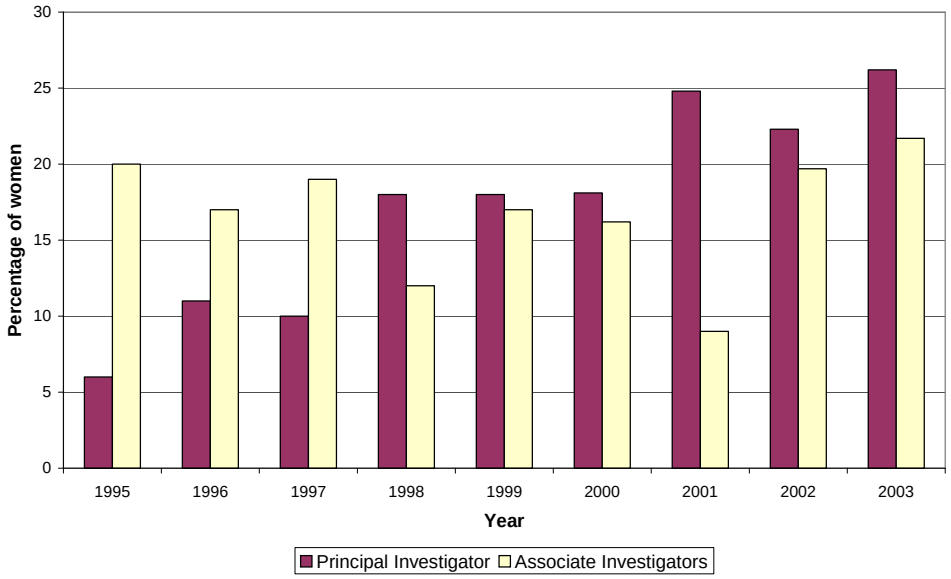
Figure 38. **Experience of associate investigators (AIs) on contracts awarded in 2003/04, as measured by the number of years since the associate investigator obtained their highest degree.**



Women Researchers

In 2003/04, 26% of the principal investigators on successful applications are women. For science projects (excluding the social sciences and humanities), the figure is 20%[16].

Figure 39. **Percentage of investigators, principal (PI) and associate (AI), who are women.**



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

Māori Researchers

The Marsden Fund has continued its activity to increase the participation of Māori in fundamental research with the highlight for 2003-04 being the first Marsden funding for an iwi-led project, "Landscape transformation and human interaction in pre-1840 Bay of Islands, New Zealand", a Ngati Hine project. For contracts active in the 2003/04 year, the percentage of principal and associate investigators who are Māori is 2.7%, although Māori researchers contribute to 4.6% of the contracts. In the 1997 Royal Society survey (referred to above), 0.7% of scientists were identified as Māori.

In the past year, the Fund has assisted Dr Charles Royal and Joana Johnston from MoRST, as they have developed an overview of Māori research and a proposed framework to assist the development of research relevant to Māori. The Fund sees this framework, with its emphasis on engaging the innovation potential of Māori people and Māori knowledge, as offering creative possibilities for the Marsden Fund.

The Fund has also contributed to a FRST-led wananga for Māori postgraduate students and a hui in Taranaki in which findings from Marsden research were discussed with Ngati Mutunga.

The Marsden Fund welcomes Māori participation. Its activities in the past year to support this have built on earlier initiatives which include: publicising the Marsden Fund amongst Māori groups; publicising research conducted by Māori or of specific interest to Māori; participating in hui related to research, science and technology; and introducing a "Māori responsiveness" section into Marsden applications.

APPENDIX II

MARSDEN FUND CONTRIBUTION TO ISSUES OF PUBLIC INTEREST

Table 15. Marsden Fund Contribution to Issues of Public Interest

Issue	No. of projects[17]	Funding ($ million)	Description
Genetics	132 (incl. 42 for use as a tool)	13.0 (incl. 4.0 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; and use as a routine tool to sequence DNA, for evolutionary, ecological and historical studies.
Environment	64	5.3	Projects are investigating aspects of ecology, biodiversity, population genetics, plant physiology, oceanography and atmospheric science. Projects 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	74	7.8	Most projects concentrate on fundamental aspects of biochemistry, cell biology and genetics. The focuses of the projects 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	0.90	Archaeology, language, settlement, museum practise, rangatiratanga, and Ta Moko.
Children and adolescents	8	0.74	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	11	0.89	Plate tectonics, volcanic and seismic activity.
Climate change	10	1.5	Projects 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	18	1.3	Computer architecture, software, data transmission, virtual reality, machine learning, numerical computation and the theory of computation.
New materials and nanotechnology	30 (incl. 7 in nanotech)	2.8 (incl. 0.57 in nanotech)	Investigating new materials, including developing materials and material processes for nanotechnology.
Developmental biology	46	4.8	Investigating various aspects of plant and animal development (eg. muscle

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

			development, the control of flowering), as well as various aspects of learning and memory development.

APPENDIX III

AREAS OF STRENGTH AND UNDER-REPRESENTATION IN MARSDEN-FUNDED RESEARCH

Table 16. 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)	Animal physiology, animal developmental biology.
Ecology, Evolution and Behaviour (EEB)	Molecular evolution, population genetics, 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 palaeoclimatology, 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.

Table 17. 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)	Neurophysiology, psychology, biochemistry, enzymology, plant and animal genetics
Ecology, Evolution and Behaviour (EEB)	Physiological ecology, marine ecology, animal behaviour, experimental psychology
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)	Surface hydrology, "core" soil science and hard-rock geology/geochemistry, astronomy.
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 (though there were few applications from theoretical seismology and information systems).
Social Sciences (SOC)	Sociology, business, politics.

APPENDIX IV

SURVEY OF FAST-START RESEARCHERS – OUTCOMES, BARRIERS, AND PRIORITIES

Recipients of Fast-Start grants awarded in the 2001, 2002 and 2003 funding rounds were surveyed in order to find out:

- what effects the grants had on their further work and career progression;
- whether they felt the scheme provided adequate support; and
- what their priorities were for development of the scheme.

Of the 65 recipients surveyed, 58 responded (89% response rate). 14 of the 58 had completed their Fast-Start grants (representing all but 2 of the completed grant holders).

Further work after completion of Fast-Start grant

For 13 out of the 14 completed grant holders, the Fast-Start grant had led to further work.

When asked to provide a description of the further work, the following answer types were given:

- 13/13 (100%) said that it had led to an extension of the project or development of new ideas or a related project;
- 7/13 (54%) said it had allowed them to develop new collaborative work;
- 4/13 (31%) stated that they had been successful in gaining further funding to extend their Fast-Start research (note however, that this is likely to be an underestimate as they were not asked directly about further funding);
- 1/13 (8%) said it had led to consultancy work; and
- 1/13 (8%) said it had led to some public outreach activities.

Why do researchers apply for Fast-Start grants?

In response to a question asking why they applied for a Fast-Start grant rather than a full Marsden grant, the overwhelming response was that they felt their chances of success were higher when not competing against more established researchers (74% of the 58 respondents).

Other reasons given were:

- 24% said they applied because the scheme was targeted to their career stage;
- 3% stated that they had previously applied unsuccessfully for a standard Marsden grant;
- 9% thought that the Fast-Start grant would allow them to grow their research into a competitive standard Marsden grant proposal;
- 9% thought it would be a good way to get themselves and their research established;
- 7% said they applied because they had a small project in mind that was appropriate for a Fast-Start grant;
- 7% said it allowed them to develop their own research project without the burden of managing a large piece of work or having to collaborate and negotiate with others;
- 7% said that they felt that their speculative/risky research topic would have a higher chance of success in Fast-Start round;
- 5% said that at the time of applying they did not have the NZ contacts or knowledge necessary to lead a larger project suitable for a standard Marsden grant.

Several mentioned having to decide between the higher chance of success in the Fast-Start competition, and the larger sum of money available in a standard grant. They had concluded that it would be better to get at least some money from a Fast-Start grant than to get none from a failed standard bid. Others did not mention this trade-off, stating that the grant size was appropriate to the project they had in mind and/or to their career stage.

For one third of recipients, their successful Fast-Start bid was the first application made for own research funding (excluding prior Fast-Start bids and applications for scholarships or fellowships).

Influence on career progression

Recipients were asked if the grant had affected their career progression, and if so, in what way. 74% said that it had affected their career, while the remaining 26% said no or not yet.

The ways in which it affected career progression included:

- Raising the researcher's profile or prestige, e.g.
  "There is a sudden recognition that what you are doing must be good if Marsden are willing to fund it."

  "My 'stock' has risen within the department as a consequence of successfully attracting funding which carried overhead. The Marsden Fund is regarded as the most prestigious and the most difficult funding to obtain within my department."

  "Receiving such a prestigious grant early in my career has given me the opportunity to demonstrate my ability to procure funding and undertake a research program independent of other established scientists."

- Assisting in gaining promotions, further funding, and improved PBRF ratings. Of particular note, 21% stated that the grant had contributed to a promotion or to success in gaining a new job.
- Establishing their own research base:
  "After returning to NZ from … overseas, the Fast-Start Marsden gave me the opportunity to establish the foundations of a study system in NZ with which I am now continuing to investigate the … questions that are the focus of my career."

  "It gave me a chance to initiate a project and begin to establish a research program at the University. Without this I think I would probably have given up and gone back (overseas)!"

  "It is very difficult for a young academic to get started with research, especially because of the teaching commitments, which are particularly heavy at the beginning of the career. In my case (which is getting to be so common to have almost become the rule in my discipline) the situation is made worse by the fact that I came to my department from another country and had to learn the whole institutional, educational, and social setting in addition to everything else. It is fair to say that my ability to pursue a satisfactory research program would have been severely hampered without Marsden's assistance."

  "It's certainly the best thing that's happened in my career. Firstly the project is a great topic and a new research field for me, and one that I expect to remain a life-long speciality. I'm particularly pleased that the Fast-Start scheme makes explicit provision for embarking on new specialities. This stage in the career (5 years post-Ph.D.) is an

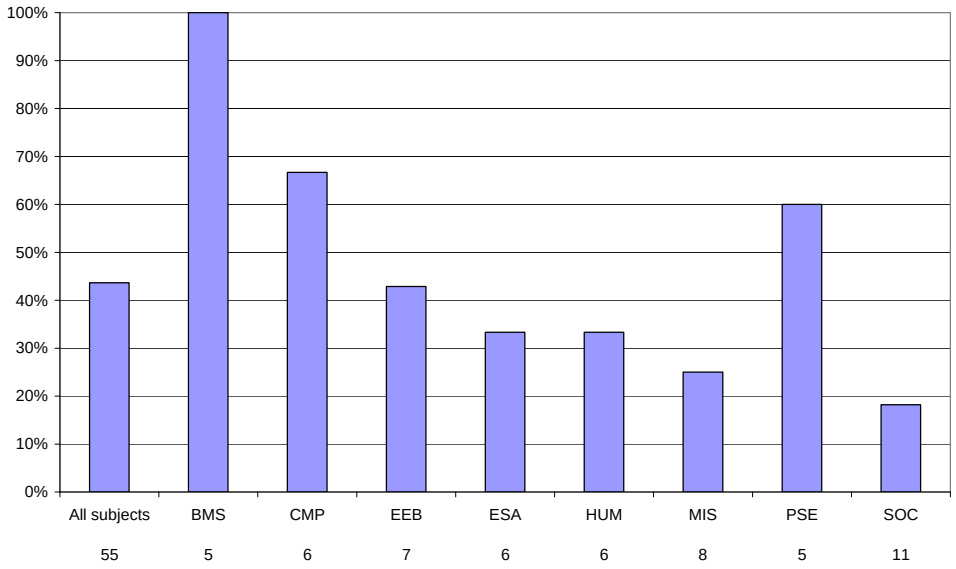
excellent time to establish a research area and research team. This was my first opportunity to embark on my own research programme, rather than slotting in with other people's research"

- Giving them the opportunity to generate publications and develop research collaborations and networks.

Does the scheme provide sufficient support to launch a research career?

Overall, just over half (56%) said that they thought the scheme provided sufficient support to launch a research career. Responses to this question did not vary significantly by institution type (University/CRI/private), but did vary across subjects (Figure 40). Respondents in the biological areas: BMS and CMP, and in physical sciences and engineering (PSE), were less likely to feel that the scheme provided sufficient support.

Figure 40. The percentage of respondents, by subject, who feel that the Fast-Start scheme was not sufficient to provide support to launch a research career. The numbers below the graph give total number of responses (yes and no) from each subject area.



Key: BMS: biomedical sciences; CMP: cellular, molecular and physiological biology; EEB: evolution, ecology & behaviour; ESA: earth sciences and astronomy; HUM: humanities; MIS: mathematical and information sciences; PSE: physical sciences and engineering; SOC: social sciences.

When asked for comment, both positive and negative aspects were highlighted. Positive aspects included:

- the grant size/duration is adequate;
- the prestige of the grant and the way in which this opens doors for recipients;
- the value placed on the ability to 'buy-out' time from teaching and other duties, and;
- the way in which the scheme enables young researchers to do their own, individual work and 'get out from under' established researchers

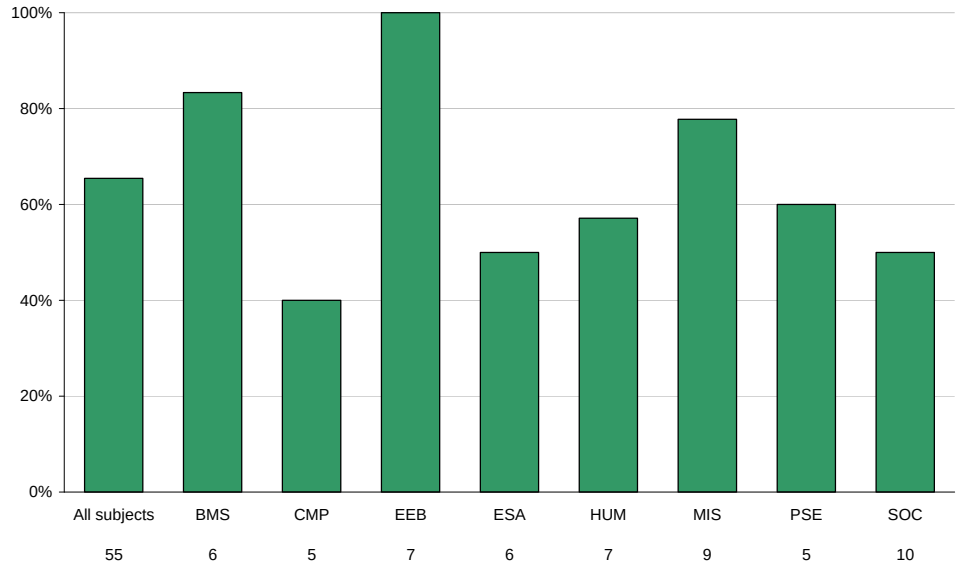
Negative aspects focussed mostly on the small size and short duration of the grants, and the restrictions this placed on recipients. (See the next section for more information on restrictions.) A number mentioned that they thought the recent rise in funding cap from $50,000/year to $70,000/year would help to address these problems.

Many discussed a tension in relation to the capacity of the scheme to launch careers: in their opinion, while the grant helps immensely to develop prestige and launch an independent piece of research, it is too small to really build research momentum. This means that recipients must gain additional funds in order to fully establish their research. Some discussed this as a positive aspect; motivating young researchers to take initiative in building their own careers. Others discussed the negative ramifications: the limits this placed on achievement, and the time consumed making extra grant applications, that could be more profitably be spent doing research. A small number of those who discussed negative aspects, nonetheless commented that it is better to provide some money to a young researcher than none, and that therefore, if a choice must be made between larger/longer grants, and more grants, they would prefer more grants.

Do the rules of the scheme restrict progress?

The Fast-Start grants are small ($50,000 per annum in 2001 to 2003), and are restricted to a maximum 2 year duration. This survey asked whether these rules had restricted recipients' progress on their projects in any way. Two thirds of recipients stated that the rules had been restrictive (Figure 41). The percentage who had experienced restrictions did not vary significantly by institution type, but did vary between subjects. The highest proportions of recipients who experienced restrictions were found in the areas of EEB (100%), BMS (83%), and MIS (78%). The least likely to experience restrictions were those in the areas of CMP (40%), ESA (50%), and SOC (50%).

Figure 41. **Percentage of respondents, by subject, for whom the rules of the scheme had been restrictive. The numbers below the graph give total number of responses from each subject area. See Figure 40 for a key to abbreviations.**



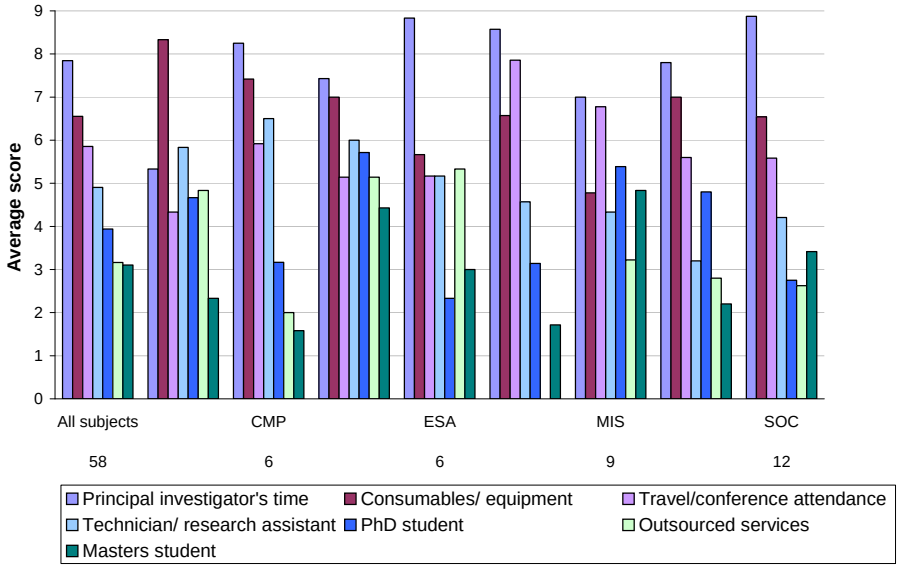
The comments made in response to this question revealed the factors that led to recipients finding or not finding the rules restrictive:

- 12% said that the rules were not restrictive because they had specifically designed their project to fit within them, and 14% said that they believe the rules of scheme are beneficial in terms of stimulating targetted work, allowing exploration of risky areas, and not placing too many burdens on young PIs;
- 30% stated that they found the 2 year duration OK, but the funding cap restrictive, while 16% said that the converse was true. A further 10% found both the funding cap and the short duration restrictive;
- The two most commonly restrictions experienced were:
- the inability to support a Ph.D. student within the rules of the scheme (14%), and;
- high institutional overheads seriously restricting the amount of money available to conduct research (16%) (comment about overheads was received in other sections of the survey also, and will be expanded on below).
- As in the previous question, a number anticipated that the increase to $70,000 per annum will make the scheme less restrictive.

What are the most important elements for Fast-Start grants to fund?

Recipients were asked to rank a number of items, from most to least important for Fast-Start grants to fund. Average rankings across all subjects and in individual subjects are shown in Figure 42. Overall, the most highly ranked area was funding of the principal investigator's own time, followed by funding for consumables/equipment, and then funding for travel and/or conference attendance. Funding for a Ph.D. student ranked below funding for a technician or research assistant, but above funding for a Masters student. This is interesting, as the grants currently may support Masters students, but are of too short a duration to support PhDs.

Figure 42. Average rankings of the importance of funding different elements. The higher the score, the more important an element is; the highest score achievable is 9. The numbers below the graph give total number of responses from each subject area. See Figure 40 for a key to abbreviations.



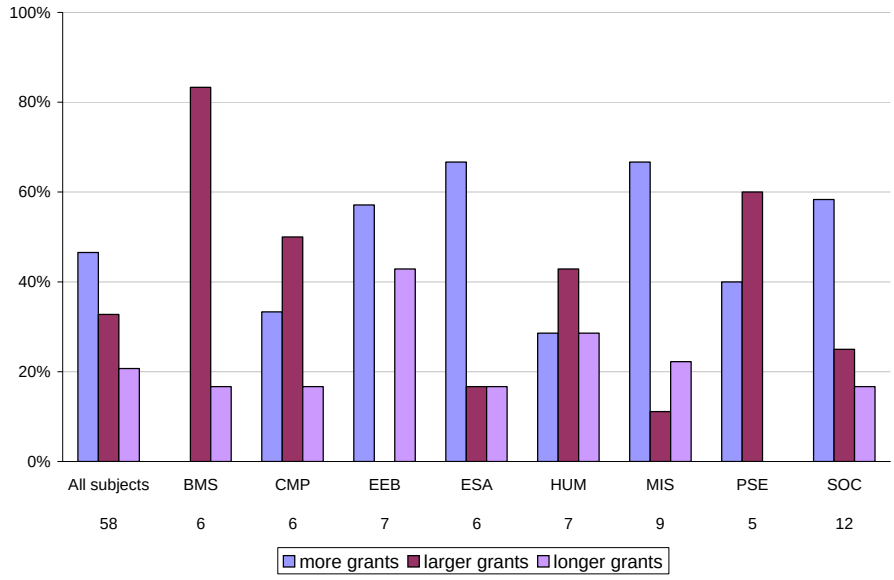
The area of BMS is notably different from the other areas in that it is the only subject in which funding for principal investigators' time is not the highest ranked item. It ranks funding for consumables/equipment almost one third higher than any other area, echoing some earlier comments made by these recipients, stating that their progress had been restricted by lack of funds to purchase consumables/equipment.

MIS also has quite different rankings from other areas, with comparatively high rankings for travel/conference attendance, and for funding Ph.D. and Masters students. Humanities (HUM) researchers also place a high importance on travel/conference attendance as compared to other subject areas.

Should the scheme fund more grants, longer grants or larger grants?

Recipients were asked which they thought would be the most beneficial if the Fast-Start scheme were to be enlarged: larger grants, longer grants, or more grants. Overall, 47% chose more grants, 33% chose larger, and 21% chose longer. Results by subject are shown in Figure 43.

Figure 43. Percentage recipients who think that the scheme should fund more grants, larger grants, or longer grants, by subject. The numbers below the graph give the total number of responses from each subject area. See Figure 40 for a key to abbreviations.



While ESA, MIS and SOC recipients were most often in support of funding more grants, the majority of recipients in the areas of BMS, CMP and PSE thought that larger grants were more important. Recipients in HUM were fairly evenly split between the three options, while recipients in the area of EEB wanted either more grants or longer grants.

The desire for longer grants in PSE and in the biological science areas of BMS and CMP may be related to the finding (described in Figure 40) that recipients in these areas are the least likely to feel that the scheme provides sufficient support to launch a research career. It should be noted, however, that since these researchers received their grants, the size per grant has increased from $50,000 to $70,000 per annum, and that this may address the problem in these areas.

OVERARCHING THEMES AND SUGGESTIONS MADE BY RECIPIENTS

Overall, the scheme is highly valued by recipients, and has resulted in some very significant career development. A number of recipients are concerned that the size and the duration of the grants may be inadequate. However, this may be mitigated by the recent increase in grant size. When asked to choose, just under 50% stated that they would prefer more grants awarded rather than longer or larger grants.

A commonly raised issue was the extent to which institutional overheads cut into the Fast-Start grants. Overall, 24 of the 58 respondents (41%) mentioned this at some point in their comments. Some examples were given of how little money was left over to conduct research after subtraction of overheads, and one person suggested that institutions should show their support for the scheme by waiving overheads for Fast-Start grants.

Respondents made various suggestions for improving the scheme. The most commonly suggested were:

- extend the duration of grants, or make extensions available beyond the two years;
- increase the size of grants;
- increase the grant size and duration; and,
- introduce flexibility in funding levels by having guidelines, but no set funding cap.

Many took the opportunity in their final comments to emphasise the value they placed on the scheme. Some comments are below:

> *"I think that establishing the Fast Start scheme was a brilliant idea. Since the inception of the Marsden fund, young researchers who came up with a good idea for a project have found it really frustrating because they know their CVs might not be competitive enough to get through the first round when compared with senior scientists with long and impressive CVs. The only way they could get their idea funded by Marsden was to collaborate with an impressive senior scientist and play second fiddle. Although this was ok in that you could get the science completed in whatever way it took, and you developed collaborative links with senior scientists, what it didn't do, was provide the emergent researcher with any kudos for the work, or career progression, as all this went to the PI who might not even have played a very significant role in the inception or completion of the work. I think this problem has now been solved with the Fast Start scheme. It provides the emergent researcher with a stepping stone towards further success."*

> *"It is an ideal start to a research career and I feel I have benefited greatly even though it has only been a few months since receiving a fast-start grant."*

> *"The Marsden fast start program is a great encouragement to scientists early in their career like myself. There are so many uncertainties after finishing Ph.D., particularly with respect to funding. So it is highly reassuring to have a small grant funded, even if it doesn't cover ones entire salary for a year (thus, I'm in favour of more, rather than bigger and longer grants). It's a great way to really start researching on your own, without the meddling of an advisor or boss and develop one's intellectual and financial independence. The existence of a pool of funding that is accessible only to only young, rather inexperienced researchers (rather than the 'big guns'), provides a more level playing field, and the confidence and experience gained from securing a small fast-start grant is helps significantly for subsequent grant writing!"*

> *"I think schemes which support young researchers are essential to the future of New Zealand science, so really strongly support the continuation of this type of fund."*

"It really has been a turning point in my career and has opened up opportunities that I'm very excited about. Thanks!"

"It has helped my research agenda in many ways already and I anticipate that there are still many benefits yet to be revealed. Unlike other funding bodies in New Zealand I believe that the Fast Start in particular and Marsden more generally really understands the nature of research and the flexibility required to get results. By ring fencing Fast Start money for new researchers Marsden ensures that there is always a new cohort of researches being fostered in New Zealand. Thus, there are people always feeding into the broader research landscape. This can only be a good thing in the long run for the country."

APPENDIX V

JAMES COOK RESEARCH FELLOWSHIPS

During 2003/04 there were nine active Fellowships:

- 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;
- A/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 Andrew Pullan (Engineering Sciences and Technologies): Detailed computer modelling of gastrointestinal bioelectric activity—completion date 06/2005;
- Associate Professor Russell Gray (Biological Sciences): Understanding our past: language trees meet computational biology—completion date 06/2005;
- Professor Ian Pool (Research of relevance to New Zealand and/or the South West Pacific): A demographic history of New Zealand—completion date 03/2006.

APPENDIX VI

PROMOTION FUND ACTIVITIES

UNSEEN WORLDS - NEW DIMENSIONS

Benson and Associates

Project Leader: Jude Benson

Awarded: $31,275

National touring exhibition of large format colour photographs featuring images from the world of science and technology unable to be seen with the naked eye and live video presentations of the scientists behind the images.

Present status:

Currently on show in Auckland, over the next two years this exhibition will travel to Wellington, Dunedin, Christchurch and Palmerston North. It will then go offshore to Australia.

TRANSIT OF VENUS WEBSITE

e-net Limited

Project Leader: Gresham Bradley

Awarded: $86,000

Development of a video website providing an interactive experience with live and produced video-streamed stories, graphics, text, web links to cover the Transit of Venus in 2004 and the schools competition resulting in nine students travelling to UK to observe the Transit.

Present status:

The website offers a range of original and archive streaming-video and audio resources, with extensive links to relevant material on New Zealand and international websites on the Transit of Venus and Captain Cook's voyages to New Zealand. Between February and July 2004, the site attracted more than two million hits with over 180,000 page views peaking as expected around the announcement of competition winners (27 April 2004) and the Transit (8 June 2004). This enormous level of activity was attributed to the Google internet search engine top listing, links from the BBC website (one of only two) and promotion through the NASA education programme. The website is still online.

BIOBLITZ

Landcare Research

Project Leader: Peter Buchanan

Awarded: $35,000

A multi-disciplinary group of scientists worked over a 24 hour period in public view to document the biodiversity in an urban environment.

Present status:

This highly successful event, a 'first' for New Zealand, was staged at end April 2004 with the erection of a publicly accessible temporary laboratory complete with computers and microscopes in a marquee. 40 scientists set up displays and participated in the counting and recording. It received good media coverage, including Radio NZ, and general public attendance despite 12 hours of driving rain and wind. A 2005 event is now being planned and the idea is being copied in the Canterbury region.

LIFE'S WHAT YOU MAKE IT NATIONWIDE COMEDY SHOW TOUR

New Zealand International Science Festival Inc

Project Leader: Emma Ramsay-Brown

Awarded: $65,680

Touring comedy show on subject of DNA. Set in a mannequin factory this show covers the science of genetics by exploring the parallels between making a shop dummy and making a person.

Present status:

National tour completed in June 2004. Presented to 10,795 students in 16 schools across New Zealand. Feedback from the students and teachers was very positive:

> *"Cool. Funny acting. I like the music, I learnt lots of things I didn't know before."*
> *"Fantastic. Please come back."*
> *"It was an entertaining way to present information. The interactive bit was very well done."*
> *"Really enjoyed and felt it did a great job of explaining genetics. Our congratulations to the actors"*

SCITECH - GET INTO IT! / TE TAIRAU - WHAIA

TEARAWAY Magazines

Project Leader: Sue Pepperell

Awarded: $70,000

Quarterly science insert in TEARAWAY researched, written and published by young people and also available online with Te Reo Māori translation via New Zealand's biggest youth readership magazine. In the words of the young writers: SciTech/Te Tairau is about proving to you that science and technology is more than dissecting frogs and fun with Bunsen burners - it's a part of our everyday lives.

Present status:

Three quarterly 4 page inserts have been published on climate change and environment, music and sound technology and mobile phone technology. The feedback from teenage readers has been excellent:

> *"I think it's a really groovy thing that you cats at Tearaway are doing. I know there's a lot of places around at the moment that claim to be youth aimed but it's great to see someone actually putting their money where their mouth is"*
> *"I think you guys did a great job, in fact I can't wait 2 c the next Tearaway Magazine!"*
> *"I found the article on the ozone layer really interesting and easy to read. There was also lots of stuff in there that I didn't know. The 'Hydrogen Power' article was good too."*

100 HOURS OF EXERCISE: HOW DOES YOUR BODY COPE?

University of Otago

Project Leader: Jim Cotter

Awarded: $53,000

Evaluation and measurement of physiological, psychological and cognitive responses of a team competing in the Southern Traverse and documentation of the process into a TV documentary.

Present status:

The team competed in the Southern Traverse Race in November 2003. A documentary has been completed and was screened nationally on TVNZ and Sky (6 times) during March and April 2004. The film contained race footage and voiced-over graphs of scientific data along with interviews with the athletes, scientists and race organisers.

HEALING THE LAND

University of Waikato

Project Leader: Gabrielle Palmer

Awarded: $37,000

The clean-up of a contaminated ex-orchard site by pioneering 'clean-up' technology and engaging the local iwi community on whose land the site stands, through workshops, demonstrations and newsletters.

Present status:

The soil clean-up technology proposed for the contaminated site involves the planting of special pollutant-tolerant trees that have been bred to remove large amounts of toxins from the ground and rapidly incorporate them into the living matter of the tree. This living matter can then be coppiced and the toxins removed from the site. The planting, establishment, coppicing and ongoing scientific measurements are being carried out by local children and interested members of the wider community. A video has been made of this ground-breaking project is internationally available and is being used to highlight ways in which environmental issues can engage young people. Workshops, public information days, presentations, newsletters, school visits and a website are also in progress.

APPENDIX VII

INTERNATIONAL SCIENTIFIC UNION MEMBERSHIP AND NEW ZEALANDERS HOLDING PROMINENT POSITIONS

- International Council for Science (ICSU)
  - Professor David Parry FRSNZ, Massey University is the Vice President of the Board of the International Council for Science
  - Professor Ian Pool FRSNZ, University of Waikato serves on the Expert Panel - Priority Area Assessment on Capacity Building in Science of the International Council for Science
- Asian Crystallographic Association
  - Professor Jim Simpson, University of Auckland is the Vice President of the Asian Crystallographic Association
- Federation of Asian Scientific Academies and Societies
- International Astronomy Union
  - Professor John Hearnshaw FRSNZ, University of Canterbury is a member of the Board of the International Astronomy Union's Optical and Infrared Techniques Commission and the Committee on Advance Programme Group Commission.
  - Associate Professor Peter Cottrell, University of Canterbury is a member of the International Astronomy Union's Commission Variable Stars Organising Committee.
- International Commission for Optics
- International Council of Associations for Science Education
- International Geographic Union
- International Geosphere-Biosphere Programme
- International Institute of Refrigeration
- International Mathematical Union
- International Mineralogical Association
- International Palaeontological Association
- International Social Science Council
- International Union for Physiological Sciences
  - Professor Tony MacKnight FRSNZ, University of Otago is a Council Member of the International Union for Physiological Sciences (IUPS)
- International Union for Pure & Applied Biophysics
- International Union for Pure & Applied Chemistry
- International Union for Pure & Applied Physics
- International Union for Quaternary Research
- International Union of Biochemistry & Molecular Biology
- International Union of Biological Sciences
- International Union of Crystallography
- International Union of Geodesy & Geophysics
- International Union of Geological Sciences
- International Union of Microbiological Societies
- International Union of Nutritional Sciences
- International Union of Radio Science
- International Union of Soil Science
- International Union of Theoretical & Applied Mechanics
- Scientific Committee on Antarctic Research (SCAR)
  - Dr Clive Howard-Williams FRSNZ, NIWA, Vice President of the Scientific Committee on Antarctic Research

- Professor Bryan Storey, University of Canterbury is a member of the Scientific Committee on Antarctic Research Geoscience Standing Scientific Group
- Scientific Committee on Oceanic Research (SCOR)
  - Dr Julie Hall, NIWA is the Secretary of the Executive Committee of the Scientific Committee on Oceanic Research
- Scientific Committee on Problems of the Environment
- Scientific Committee on Solar-Terrestrial Physics