THE ROYAL SOCIETY OF NEW ZEALAND
PROGRESS AND ACHIEVEMENTS REPORT

OCTOBER 2005

Promoting excellence in science and technology

This document differs from the one presented to government in that financial details of the Society's operations, and its budget recommendations, have been removed.

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EXECUTIVE SUMMARY

This year the Society wishes to make a strategic case to engage with the Ministry of Research, Science and Technology to enable us to fulfil the intent of our Act and to partner with government to achieve its ambitions for New Zealand's innovation system.

Our role is seen as essential by the science community, and we wish to signal our desire to increase our base of operations as New Zealand's academy of science and technology.

Currently, the Society operates on an annual income representing the payment from MoRST for the current output agreement. In addition, the Society has contracts with other government departments and the private sector, and receives income for the Society's members and assets. We propose to double our role over time, in support of both our Act, and government's own goals for the science and innovation sector.

The Society wishes to enter into discussions with the Minister and Ministry on ways in which its full role under its Act might be supported. Our aspirations are limited by the resources available to fulfil the mandate our Act lays down. We have been pleased to deliver against individual MoRST contracts in recent years, but would prefer to contribute at a programme level in support of goals for New Zealand science.

THE SOCIETY'S PROGRAMMES, UNDER ITS ACT OF 1997

Awareness and Communications
The Society sees its awareness work as developing and building a whole programme area. Four years ago we used largely our own resources to create a communications unit. We believe that significant advances can now be made by a step change in the work of this unit. Their immediate task would be to develop a strategic plan, in discussion with both MoRST and the Council of the Royal Society, so that the most effective set of goals and programmes could be put in place. Part of their work would be to drastically improve the societal impact of government's Promotions Fund by anincrease to allow more high quality projects to receive funding.

Education – inspiring our younger generations
Inspiration of our younger generations is a high priority in the fulfilment of our Act, and we maintain an education staff of 7, who raise more than half of their operational funds from sources other than government. The Society stands ready to play a considerably stronger strategic role in fulfilling its S&T educational mandate.

We propose that a coherent programme be developed for **teachers**, extending beyond the current Teacher Fellowships to include short-term internships, one-day courses on content, professional seminars, and participation in international events.

We wish to provide a comprehensive set of outstanding programmes for **students** in all schools in New Zealand, and seek resources to achieve this. For example, CREST Awards, the international Science Olympiads, our Young Achievers programme, our Talented School Student Travel Award (TSSTA), the Lindau Nobel meeting and more.

Overall, the Society proposes a phased increase of staff in this area, eventually by up to 6 FTE. The immediate task of the unit would be to develop a strategic plan, in discussion with MoRST and the Society Council. The Society proposes that funds be made available for 2.8 positions, plus assistance for the Olympiad programme in 2006.

Expert Advice
We wish to develop a highly professional relationship with government, raising the profile of S&T and its contribution to the knowledge society. We propose ongoing support for the Society to conduct a number of major enquiries each year. We will need to further develop our strategic analysis capability if we are to undertake such activities on a sustained basis. The programme area will require the support of 4 FTE (up from the current 2), and funding to support panel discussions. The Society sees this as a shared activity, augmented by government support for 2 FTEs plus panel costs.

Supporting Excellence
We develop, recognise and celebrate excellence in research. The Marsden and James Cook Funds provide resources for our top researchers and the Royal Society medals honour the exceptional. Our Academy Council recognises and puts to work for New Zealand the excellence embodied in the Fellows of the Royal Society.

The **Marsden Fund**, administerd by the Royal Society under an MoU with the Marsden Council, develops research capability in our best and most productive people. Marsden researchers are twice as productive as the national average. The Fund has grown from $5.5 million in 1995 through $25.8 million in 2000, to $38.2 million in 2005. We calculate that an increase is now needed to resuscitate our ability (which currently depends on employee-donated time) to manage the Fund according to the expectations of the Ministry and the science community. The size of the Fund could be doubled and still fund only those projects rated among the top 20 % in the world. We recommend growing the Fund to $60 million per annum by 2009.

The **James Cook Research Fellowships** allow 5 or 6 of our best researchers to concentrate on their chosen research for two years. However, the fund has remained constant since its inception in 1998, and can no longer support MoRST's original intent. We recommend that the value of the fund be restored, and that there be further increases to support 12 fellows, with a concomitant increase to administer the fund.

Lastly, the national science medals demonstrate the Government's support for the best and the brightest. We support government's aim of raising the profile of the Rutherford Medal, and we recommend an annual award with the medal. We also recommend that MoRST support the Pickering Medal.

Supporting the Profession

We encourage our members and constituent organisations to act as leadership models in developing and using S&T knowledge. Much of our work in this area currently uses our own resources. We are particularly active though Society committees (averaging around 20 workshops/meetings per year), our international linkages, and publishing. Our professional support activities include:

- **studies on leadership qualities for innovation;**
- **active international linkages and memberships;**
- **committees and workshops in (e.g.). social sciences, Antarctic research, climate change, human resources, care of research animals, astronomy, and education;**
- **policy and strategy papers;**
- **newsletters and daily news for scientists and technologists;**
- **courses on communication for scientists;**
- **publishing 8 New Zealand learned journals;**
- **engagement with Māori science and technology;**
- **support for our 60 or more constituent science organisations;**
- **conference support for young professionals;**
- **a suite of medals, national awards event and professional science week;**
- **distinguished speakers series.**

Scientific Journals

The Society publishes 8 refereed scientific journals on contract to government, at a time when the world is moving inexorably to open access. We propose a new funding model whereby government contributes additional funding to allow us to phase out subscription charges, and phase in increased page charges for authors. The move will showcase New Zealand research to the world. The alternative is a loss of profile for New Zealand science publishing.

International Activities

This area has been characterised in recent years by a number of small and short-term contracts to the Society to assist parts of larger programmes. We wish to play a considerably stronger strategic role, in support of, and in conjunction with, government's own aspirations in this area. We propose that the Royal Society's international section be augmented to support the development and administration of the increasing number of international agreements now being put in place.

We propose to support the Ministry's objectives by expanding the ISAT contestable fund by 20 % each year, to reach $1m by 2010. Also, an expected increase in international membership charges will require a further support to maintain our current presence. We further propose that the international opportunities fund currently administered by FRST and HRC be extended to include a programme for joint basic research, administered by the Royal Society. We have already established agreement in principal with Germany to examine joint funding of joint research.

Lastly, we are keen to support Objective 3 of the government's International Investment Opportunities Fund by taking on the necessary search and selection processes to bring an outstanding international research team to New Zealand.

RECOMMENDATIONS AND PRIORITIES

In addition to our top priority this year, the Marsden Fund, we make a case for a strong strategic partnership with the Ministry to enhance its own programme goals, as well as those of the Society.

Our priorities are:

1. **The Marsden Fund**
2. **A National Science Strategy Panel**
3. **Focus on Research Excellence (FoRE) – A Study of the Outcomes of Investing in Excellent Basic Research**
4. **Royal Society Sustainable Energy Panel**
5. **International Initiatives**
6. **Education Initiatives**
7. **Communications Initiatives**
8. **A New Publishing Business Model**

PART A: FULFILLING OUR MISSION: STRATEGIC DIRECTIONS

This year we present our report in three parts, as the Society wishes to make a strategic case to engage with the Ministry of Research, Science and Technology to enable it to fulfil the intent of its Act and to partner with government in achieving its ambitions for the New Zealand science and innovation system.

Part A of this Progress and Achievements report gives an overview of the ways in which Ministry of Research, Science and Technology programmes and Royal Society programmes interact to support each other, and the potential that exists for a greater partnership. Financial implications are summarised here. Part B of this report outlines those activities contracted to the Ministry through its annual agreement with the Society. In Part C we present detailed reporting information from our evaluations.

Our priorities are:

1. The Marsden Fund
2. A National Science Strategy Panel
3. Focus on Research Excellence (FoRE) – A Study of the Outcomes of Investing in Excellent Basic Research
4. Royal Society Sustainable Energy Panel
5. International Initiatives
6. Education Initiatives
7. Communications Initiatives
8. A New Publishing Business Model

THE ROYAL SOCIETY

The Society was established in 1867 as a body of excellence and enquiry into matters scientific. Our activities are supported by over 1300 members, 363 Fellows, 21 Companions, 50 societies, 10 branches, 10 affiliates, and a staff of 36 FTE in Wellington, with an operating budget of which the majority comes from MoRST in payment for our Funding and Investment Agent activities. Our Act of 1997 mandates us to:

Contribute to New Zealand society:	Support New Zealand's S&T community:
1. Promote public awareness, knowledge, and understanding of S&T	4. Encourage, promoting, and recognising excellence in S&T
2. Advance S&T education	5. Provide support and a conduit for the professional needs and development of scientists and technologists
3. Provide expert advice on important public issues to the government and the community	6. Establish and administer for all members a code of professional standards and ethics in S&T

In fulfilling our mandate under the Act, we serve five main client groups:

Our members and the New Zealand science and technology community
The work of government in its support of science and technology
Students, teachers and parents
The public and the media
Industry and the users of science and technology

Table 1. Correspondence between RSNZ's mandate and MoRST contract requirements.

The weight of MoRST funding is placed on supporting excellence and supporting promising individuals. Less weight is placed on the Society's other mandated areas of awareness, expert advice, and standards and ethics.

8 MoRST Output Classes	RSNZ: 6 Categories under our Act ● = MoRST funding ♣ = Other Govt funds ♥ = RSNZ /Non-Govt					
	Awareness	Education	Expert Advice	Supporting Excellence	Supporting the Profession	Standards and Ethics
1. Contract fee (not Marsden)	●	●	●	●	●	
2. Marsden Contract fee				●		
3. Marsden Fund				●		
4. Promising Individuals	♥	●♣♥		●♥	♣	
5. International Linkages Fund					●	
6. S&T Promotion	●♣♥	●		●		
7. Publications		●			●♣♥	
8. International memberships etc.					●	
[RSNZ own funds for advice/ international/ ethics]		♥		♥	♥	

THE ROYAL SOCIETY IN THE NATIONAL INNOVATION SYSTEM

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

The Society has taken an increasingly active role in recent years, with more than 30 new initiatives under way. The role we play is seen as essential by the science community, and we wish to signal our desire to increase our base of operations as New Zealand's academy of science and technology. Currently, the Society operates on an annual income, of which the majority million represents the contract amount paid by MoRST for the Society to administer several contracts and funds. Other government departments, and the private sector also contribute, while the Society's members and assets provide additional income.

The Society draws on its contract capital charge and its non-government income, to fulfil, within the means at its disposal, the objectives assigned to it under its Act of 1997. Unlike some other academies, the Society receives no outright grant from government.

All of the activities enabled under the contract from government (Marsden Fund, Teacher Fellows, Promotion Fund, International linkages, etc.) are vital to New Zealand's science system, and the Society is able to create very effective synergies and interactions with its own programme of work. Nevertheless, our aspirations are severely hampered by lack of resources to properly fulfil the mandate our Act lays down. There has been a tendency in recent years to award small, short-term contracts to the Society, sometimes within the purchase agreement and sometimes separately. The Society has been pleased to deliver results against these contracts, but would prefer to contribute at a programme level in support of goals for New Zealand science, rather than at a supplemental level.

THE SOCIETY'S PROGRAMMES, AS MANDATED UNDER OUR ACT

AWARENESS

MoRST's 2005 Research Report: *Science and the General Public* shows encouraging improvements since 2002 in public trust of science, and corresponding lower levels of feeling that science is out of control. Nevertheless there is "still a significant level of desire for government control over scientists, and accountability of scientists to the public…" The Royal Society estimates that it has been partly responsible for the improvement since 2002 in the "perceptions of the contribution science makes".

A key finding of the report is that "The majority would expect to access information from a professional scientific source". The Royal Society is arguably one of the most credible and representative scientific sources. Media sources are considered much less trustworthy, although one expects that Radio New Zealand's National Programme would be a notable exception. The survey also finds that over 40 % of people feel they are receiving too little information.

The Society is one of a few organisations that act on a national scale to promote understanding and awareness of the value of this innovation. We carry out many of these activities under our mandate with our own funds, as well as funds from private sector companies, trusts, and the Ministries of Education, Economic Development and Research, Science and Technology. Through these activities, we hope to promote an informed and critical awareness of science and technology.

There is a clear demand for credible communications about science. We believe that significant inroads could be made from an increase of three FTEs, for a total of five in the unit. Their immediate task would be to develop a strategic plan for the area, for discussion with both MoRST and the Council of the Royal Society, so that the most effective set of goals and programmes could be put in place. The Society therefore proposes that funds be made available for three positions beginning in 2006. Part of their work would be to drastically improve the societal impact of government's Promotions Fund by a fund increase to allow more high quality projects to receive funding.

It is important for New Zealand that the Royal Society continue and expand this essential communication work. National programmes such as the 50th Anniversary of DNA, the Transit of Venus and $E=mc^2$ (Year of Physics) create a very positive background environment for science and technology, engaging the interest of the wider population and helping them to understand new developments and think about the ethics involved.

As a case in point, we are also developing a new role at the interface of science and industry. To promote the change to a high-tech, high-value industry base, we are working for a mutual understanding between science and industry on questions of innovation. We have teamed with NZTE to develop and implement *Once Upon a Leader*, a leadership model from the stories of contemporary business leaders. Our Science to Business Communications Course aims to enable real communication between scientists and business people.

EDUCATION

The Society believes that inspiration of our younger generations is a top priority in fulfilment of our Act, and we maintain an education staff of seven, who raise more than half of their operational funds from sources other than government. The Ministry of Research, Science and Technology supports, through the Society, teacher fellowships ($3.4m in 2004), help for promising students, and some information publishing. However, the current levels of assistance for students have not been able to "turn the tide" of numbers of students taking an interest in science. The Society stands ready to play a considerably stronger strategic role in fulfilling its S&T educational mandate.

Teachers

Science and technology teachers are engaged in a highly demanding profession. They are struggling to educate in the broader sense, whilst beset with requirements that encroach on their creative time.

It is difficult for teachers to lift their sights above the parapet of their classroom, teaching programme and students. We seek to help teachers to develop their knowledge, skills and attitudes, and to learn about and use the resources around them.

The NZ Science Mathematics and Technology Teacher Fellowships provide in-service professional development for teachers. The value of this programme to teachers and students has been amply demonstrated (Jordan and Gault, 1999; Spratt and Knox, 2000). 64 Teacher Fellowships were awarded for 2006; representing 0.15 % of S&T teachers.

We propose that a package of opportunities be developed for teachers, extending from the current Teacher Fellowships to include short-term internships, one-day in-service courses on pedagogical content, professional seminars, and participation in selected international events.

Secondly, the participation of teachers in such programmes as the US Space Camp and Harry Messells Science School has provided a small number of teachers with increased knowledge, access to resources, and enhanced relevance for their teaching. This has in the past been at personal cost to the participants, thus restricting accessibility. We recommend a resource be established to support such interaction and participation in the future.

The support required for teacher initiatives would be determined during a scoping exercise, but initial estimates suggest that a start-up operating funds and 1.5 FTE.

Students

We wish to provide outstanding programmes in all schools in New Zealand, and seek resources to achieve this. For example, we seek to provide stability of operation into the future and assist in the raising of private sponsorship for the CREST Awards. We also propose that New Zealand invests in supporting teams to the international Science Olympiads. We further propose to strengthen our Young Achievers programme by introducing dedicated web interactivity and increasing the number of young people benefiting from participation in international science and technology events (for which we have requested 0.2 FTE for management of the Talented School Student Travel Award) and extending such opportunities to the tertiary level, such as with the Lindau Nobel meeting. We seek to continue New Zealand's participation in this event.

This year we have launched a student work experience scholarship for secondary and undergraduate students. From the interest shown to date, these scholarships will be keenly sought and provision in the future would be highly beneficial to encouraging and supporting young people in sciences and technology. Expansion of this project would require 0.5 FTE and scholarship funds.

The Society therefore proposes that funds be made available for 3.3 positions beginning in 2006, including immediate assistance for the Olympiad programme.

Overall, the Society proposes a phased increase of staff in support of student initiatives, eventually by up to six FTE. The immediate task of the unit would be to develop a strategic plan for the area, in discussion with both MoRST and the Council of the Royal Society, so that the most effective set of goals and programmes could be put in place. These would include ways to leverage and supplement private sector funding, and support for tertiary students.

EXPERT ADVICE

The Royal Society's Act mandates it to "provide expert advice on important public issues to the government and the community". To achieve this, the Society can call upon an incomparable resource from its own Fellows and members and from other national and international experts. In addition its non-aligned position gives it convening power to bring together diverse interests and organisations in a less combative setting.

Two years ago, the Society created, with its own resources, a two-person policy unit to develop evidence-based inputs on science issues. Since that time, the Society has won some small contracts from government to provide advice and to administer advice panels. This role contrasts strongly with the role ascribed to other science academies and Royal Societies around the world.

We believe that the Society has a much stronger role to play in the development of advice and input to government. The Society has the expertise and capability to respond to requests for expert panels on: topics of interest to government; strategic overview panels to consider and integrate differing points of view; dialogue and public hearings panels on controversial topics.

The Society's own policy unit works with stakeholders to achieve environmental, economic, and social goals for New Zealand. Our members expect us to channel evidence-based policy advice to politicians and ministries, and contribute to politicians' knowledge of S&T issues. We use our Fellows, members, experts, and constituent organisations to provide the facts and rapid, balanced, impartial advice on important issues for debate among government departments and the public, e.g. research funding and capability, S&T education, environmental, and social issues.

We support the growing role of consultation and evidence-based public policy and can connect policy makers with informed advice from New Zealand experts. We produced three major papers last year on S&T Capabilities in NZ, large-scale equipment, and tax incentives for R&D. We prepared the Science Case for New Zealand's investment in the Australian Synchrotron and ran a Biotechnology *Futurewatch* for MoRST. Currently the Society is hosting an expert panel on Sustainable Energy, is considering the establishment of a national strategic science panel, and plans to conduct an assessment of the Marsden Fund's basic research in New Zealand.

We wish to develop a highly professional relationship with government, raising the profile of S&T and its contribution to the knowledge society. This will enable us to act as a link between science and government by translating and communicating areas of science that can inform policy and increase dialogue among society, government and S&T. In particular, we propose ongoing support for the Society to conduct a number of major enquiries each year (see Proposals for New Initiatives on page 17).

We will need to further develop our strategic analysis capability if we are to undertake such activities on a sustained basis. The programme area will require the support of 4 FTE (up from the current two), and significant ongoing funding to support panel meetings and discussions. The Society sees this as a shared activity, using our own funding for the two current FTE, augmented by government support for two more, with attendant panel costs.

SUPPORTING EXCELLENCE

We develop, recognise and celebrate excellence in research. The Marsden and James Cook Funds provide resources for our top researchers and the Royal Society medals honour the exceptional. Our Academy Council recognises and puts to work for New Zealand the excellence embodied in the Fellows of the Royal Society.

The **Marsden Fund** is administered by the Royal Society under a contract to government and an MoU with the Marsden Council. The fund has three main impacts. It develops research capability in our best and most productive people but it also acts as a strong source for the new ideas that the rest of the system builds upon. Marsden researchers are twice as productive as the national average. Marsden research is the spark. The complementary parts of the RS&T system are designed to turn that spark into a blaze. The Fund has grown from $5.5 million in 1995 through $25.8 million in 2000, to $38.2 million in 2005. Since 2000, the annual number of applications has risen from 756 to 897 (with a peak in 2004 of 972), and the number of contracts administered and monitored each year has risen from 330 to 400 (estimated for 2005/6). Over the same period, evaluation and reporting requirements have tripled. The work hours required to administer the increased fund are estimated as 6 FTE, (up from 4 FTE in 2000). Meanwhile, increases in the Society's contract administration fee have not kept pace with the increase in workload required. An increase is now required to resuscitate our ability (which currently depends on employee-donated time) to manage the Fund according to the expectations of the Ministry and the science community.

There is a substantial amount of high quality research not chosen each funding round. Given the Fund's record, this is a significant lost opportunity for the New Zealand science system. Based on an analysis of the international reviewers' comments and gradings each year, the Fund could be doubled and still only projects rated as among the top 20 % in the world would be chosen. Bearing in mind the desirability of maintaining the prestige of the Fund, a 66 % increase of $21.83 million over the next 3 years is recommended to take the Fund to $60 million per annum.

The **James Cook Research Fellowships** allow 5 or 6 of our best researchers to concentrate on their chosen research for two years. However, the fund has remained constant at $720,000 since its inception in 1998, while fellows' costs have increased substantially. The fund can no longer support MoRST's original intent. While fellowships should not be so easy to obtain as to lose prestige, the erosion in fellows' stipends is itself leading to a reduction in the scheme's desirability in the eyes of applicants.

We recommend that the purchasing power of the fund be restored through an increase in fund size. Further increases to support 12 fellows, with a concomitant increase to support increased administration would require additional finance.

Lastly, the national science medals demonstrate the Government's support for the best and the brightest. We recommend raising the profile of the Rutherford Medal, which is the national science medal, by associating it with a monetary award. We also recommend that MoRST support the Pickering Medal for technology.

SUPPORTING THE PROFESSION

We support the professions involved in science and technology by encouraging our members and constituent organisations to act as leadership models in developing and using S&T knowledge. Much of our work in this area currently uses our own resources. We are particularly active though Society committees (we average around 20 workshops/meetings per year), our international linkages, and publishing. Our professional support activities include:

studies on leadership qualities for innovation;	publishing 8 New Zealand learned journals;
active international linkages and memberships;	engagement with Māori science and technology;
committees and workshops in (e.g.). social sciences, Antarctic research, climate change, human resources, care of research animals, astronomy, and education;	support for our 60 or more constituent science organisations;
policy and strategy papers;	conference support for young professionals;
newsletters and daily news for scientists and technologists;	a suite of medals, national awards event and professional science week;
courses on communication for scientists;	distinguished speakers series.

SCIENTIFIC JOURNALS

The Society publishes 8 refereed scientific journals on contract to government. They cover agriculture, botany, crops & horticulture, geology & geophysics, marine and freshwater, zoology, natural history, and social sciences. All journals are sold internationally, with 60 % going overseas. We introduced online publishing in 2002, and have digitised the content of all journals back to 1994.

We publish the 8 journals at a time when the world environment for journals is moving inexorably to open access. Publication in this mode requires a different business model, and discussions have been underway with MoRST to move to a new model. Journal subscription incomes are falling away, as readers turn to on-line journals at no charge. The Society estimates that it must subsidise its government contract, as new arrangements have not yet been negotiated.

We propose a new funding model whereby government contributes additional support **in 2006/7** to allow us to phase out subscription charges, and phase in increased page charges for authors. The amount proposed is minuscule compared with the $600 or $700 million invested by government in New Zealand science. The move will allow world readers to reference New Zealand articles and will showcase New Zealand research to the world. The alternative is a loss of profile for New Zealand science publishing.

The Society also seeks a small increase for its Alpha publications, including publication in Māori.

INTERNATIONAL ACTIVITIES

The need to engage with the best scientists worldwide is becoming increasingly important to New Zealand researchers if they are to remain at the forefront of world-class science. The Society is developing its own strong relations with science organisations in Europe, the Americas and Asia. With government funding, we support membership of 32 international scientific unions, provide information about international funding, and manage government's ISAT contestable fund for international visits ($560,000 in 2005-06). We also manage a small fund for MoRST to help organisations to bring international conferences to New Zealand. We use our own resources to help emerging scientists to attend their first overseas conference, to link with the science diaspora, and to bring outstanding international speakers to New Zealand. To deal with increasing demand as MoRST concludes memoranda of understanding and relations with more countries around the world, we propose to support the Ministry's own objectives and work programme by expanding the ISAT contestable fund by 20 % each year, to reach $1m by 2010. Access to global resources develops New Zealand's RS&T capacity, expertise, confidence and knowledge base.

While MoRST support in this area contains one or two stable elements – notably funding for international memberships and for scientist interchanges, the area has been characterised in recent years by a number of

comparatively small and short-term contracts to assist parts of larger programmes. In essence, the Society has been used as a sort of "office overload" in dealing with contracts that come up during the course of a year.

The Society appreciates that the Ministry is itself developing its own policies and approaches to international relations. We wish to play a considerably stronger strategic role, in support of, and in conjunction with, government's own aspirations in this area. The Society maintains close links with the world's most important science bodies – other science academies, international science unions, funding bodies, think-tanks and government policy units. We propose that the Royal Society's international section be increased from 0.75 to 2 FTE, and be contracted to support the development and administration of the increasing number of international agreements now being put in place.

We further propose that the international opportunities fund currently administered by FRST and HRC be extended to include a programme for joint basic research, administered by the Royal Society. In preparation for a government tender call last year, we have already established agreement in principal with Germany to examine joint funding of joint research (see Proposals for New Initiatives on page 17).

Lastly, an expected increase in international membership charges will require further support to maintain our current presence.

ROYAL SOCIETY OF NEW ZEALAND COMMITTEES

As well as housing an Academy, we are a federation of S&T societies. They combine resources with the Academy to form action-orientated committees in areas which the Society considers important. Examples of the committees' work in 2004 were a forum on the PBRF and a survey of human resources in the NZ research sector. Current committees and panels are:

Antarctic Sciences
Astronomy
Biodiversity
Education
Geosphere-Biosphere
Human Resources
Mathematical & Information Sciences
NZ Climate
Primary Resources
Research animal care
Social Sciences
Sustainable Energy Technology

These committees, panels and the workshops they run, form the intellectual backbone and powerhouse of the Royal Society. They support the profession, and government may also take advantage of their knowledge as an input to development of strategic goals for the science and innovation system. Our proposal above for increased support for strategic analysis will greatly augment the contributions that these committees and panels can make.

PROPOSALS FOR NEW INITIATIVES

While we wish to initiate discussions on enhancing the Society's capacity to fulfil its Act, and to support government's own goals for science and technology, we wish also to highlight four specific initiatives in this report: an international opportunity, and three strategic initiatives.

1. A National Science Strategy Panel

Given the breadth and depth of expertise that is represented by the fellowship and members, and the reach of the Society into the New Zealand community, the Royal Society of New Zealand wishes to place a new emphasise its leadership role in evaluating and communicating the strategic issues around S&T.

The Royal Society of New Zealand will establish an independent National Science Panel. The National Science Panel will enlist the nation's foremost scientists, engineers, health professionals and other experts to address the organisational, scientific and technological aspects of society's most pressing problems. The panel will act as a forum for discussion of the views of scientists from across New Zealand and focus on developing a long-term strategic science planning platform from which it will be able to better inform Government and the public on science issues. The panel will also monitoring and assess science and institutional performance and develop mechanisms for evaluating the economic and social outputs of our science system.

The Society will provide ongoing support to the Panel. This will include support for communications, secretariat, and support for establishing an experienced research unit to ensure the panel can provide well referenced and underpinning studies.

2. Focus on Research Excellence (FoRE) – A Study of the Outcomes of Investing in Excellent Basic Research

The Academy Council, which represents the Fellows of the Society, is initiating a study, currently using the Society's own means, into the outcomes of investing in research excellence in New Zealand. We strongly believe that there is a need in New Zealand for a comprehensive study of research not directed by government priorities. The study will develop a robust methodology (tested on selected projects) to determine the benefits, opportunities and constraints associated with funding excellent fundamental scientific research in New Zealand. These outcomes will be measured in scientific, technological, economic, social, cultural, and environmental terms, where possible. Qualitative indices of the outcomes of research excellence are to be used, where appropriate. The period covered by study is the past 10 years, 1995-2005. Twenty projects, known to have already started to have a wide impact, will be selected from the several hundred "excellent research" projects that have been completed over the past decade in New Zealand. An important criterion for selection of the projects is that funding was obtained in a competitive environment and based on the excellence of the proposed research (e.g. Marsden Fund or HRC project, James Cook Fellowship). These selected projects will be analysed in depth and all derivative benefit flows will be studied. Government assistance is sought to complete this phase, and to extend into a more comprehensive study of basic research, which would draw on a broader sample of grant recipients.

3. Royal Society Sustainable Energy Panel

The future of energy in New Zealand is a matter of widespread concern, touching upon our growth, health and security. The President and Council of the Royal Society see a clear need for expert advice on energy resources and opportunities. To provide that advice, the Society has set up its Sustainable Energy Panel, comprising of experts across the spectrum, from oil exploration to tidal flow generation, including experts such as Professor Ralph Sims, frequently consulted by Government on energy issues, to Dr Mike Packer, working at the Cawthron Institute on biological production of hydrogen.

The Panel intends to provide clear and timely advice on the needs and direction for future energy research and development. Beyond this, they intend to work with other groups in this area to promote education and understanding about energy issues and the opportunities available to us. Government assistance is sought to enhance this panel into an ongoing group which would continue to provide expert advice.

4. International Initiatives

4a. Joint funding schemes, initially with Germany

The Royal Society delivers the Marsden Fund which invests in investigator-initiated, curiosity-driven research. Foreign research investors, such as the Australian Research Council and Deutsche Forschungsgemeinschaft (DFG) also invest in high-quality world-class research through their Individual Grants Programme and their Coordinated

Programmes (research networks). They offer specific support to foster collaborative research by offering travel grants for overseas researchers to spend time in New Zealand institutions and vice versa.

Although some research involving either New Zealanders in ARC and DFG projects occurs, these funding agencies are largely concerned with supporting research within their own countries. The decision processes used by various countries are completely independent. Where collaboration occurs, researchers from one country generally only take a minor role in the other country's projects. There is opportunity and benefit to creating a system for more equal collaborative bilateral partnerships between researchers by allowing access to joint or coordinated funding.

We propose to set up such a scheme, initially with the DFG and the Marsden Fund, which have both signalled their willingness to collaborate. However, DFG funding cannot be secured until New Zealand funding matches it. In its initial format, the scheme would be limited to providing funding for research projects of interest to both countries. The focus will be to support proposals that demonstrate:

- High scientific merit
- Extension of knowledge
- Scientific stretch or research risk
- Capacity building
- An opportunity for the participants to build lasting relationships
- Added value through collaboration

Marsden and overseas partners will contribute the same level of funds to the scheme. As the New Zealand part will be paying the full cost of the research, but the overseas systems will not, there will be considerable leverage for the New Zealand component of the investment.

Such a fund falls within the realm of government's newly-established International Investment Opportunities Fund. However, our contention is that significant rewards are likely to come from basic research by combining teams of excellence and by avoiding questions of intellectual property which will plague more applied work. Thus, we have the consent of the Marsden Council to advise that a portion of this fund be associated with Marsden Fund processes

An initial New Zealand investment is foreseen for 2006-07, growing as Australia is brought into the scheme.

4b. Objective 3 of the International Investment Opportunities Fund

Objective 3 of the International Investment Opportunities Fund is to assist world-leading researchers, working in key areas of strategic interest to New Zealand, to relocate to New Zealand and establish a research team. While this objective has still to be scoped and implemented, it bears many similarities with setting up a Centre of Research Excellence (CoRE) in New Zealand. The Royal Society has experience in selecting and setting up such centres, and is well placed to undertake the necessary search and selection. We propose to undertake this work on behalf of government, and propose discussions to scope the work. At a first estimate, the search process could require financing, while the research team itself might require some significant support over five years, beginning in 2007/8. We have temporarily allocated the proposed expenditure under MoRST Output Class 5 - Contestable programmes of the International S&T Fund.

4c. CoLab Website

We propose that the CoLab website on European research, currently funded by MoRST, be extended to all countries.

RECOMMENDATIONS AND PRIORITIES

Below is a summary of our budget proposals for 2006-07. While our top priority this year remains the Marsden Fund, we make a special plea for a number of the smaller funds in areas where neglect over previous years has led to falling real dollars and corresponding impacts. These funds can punch above their weight, an example being the remarkably high productivity of the James Cook Fellows, whose publications per $million invested is ten times that of Marsden, which itself is twice the national average. Increasing these areas will produce high outcomes, as well as restoring them to their original intent.

Table 2. Recommended increases for 2006/7

Out-put Class	Activity
1. Awareness	
	MoRST Output Agreement 2005/6
6	**Extend the capacity of Communications Unit to manage issues and dialogue**
6	**Drastically improve the societal impact of the Promotions Fund by a fund increase to allow more high quality projects to receive funding**
1	**Increase the capacity of the Promotions Fund management to match fund increase**
2. Education	
	MoRST Output Agreement 2005/6
6	**TSSTA Management and Promotion**
6	**Information and Opportunities for Young Achievers**
6	**Work Experience Scholarships**
6	**Expanded CREST operation and promotion**
4	**Support for participants to attend each of Maths, Physics, Chemistry, Biology, Science, Earth Science, Geography and Informatics Olympiads**
4	**Scoping for short term Fellowship in 2006/7**
4	**New Fund for short term Fellowships 2007/8**
1	**Management for short term Fellowships**
4	**Contestable Fund for Teacher Travel Support**
1	**Increase in contract management for Teacher Fellows to encourage applications from less-well represented teacher groups, more new hosts organisations for Teacher Fellows, and provide more support for the new hosts**
3. Expert Advice	
	MoRST Output Agreement 2005/6
6	**Increase Strategic Analysis Capability – 2 FTEs to 4 FTEs**
6	**Panel Costs – Energy, NSSP**
4. Supporting Excellence	
	MoRST Output Agreement 2005/6
3	**Enlarging the Marsden Fund**
2	**There has been continuing growth of the Marsden Fund, an increased number of contracts, and a need for an executive with enhanced evaluation and policy analysis capacity. We recommend a step increase in the fee for administering the Fund.**
4	**Support the most productive use of research investment by restoring the sixth James Cook Fellowship and restoring third-year extensions. Expanding this highly-productive scheme to twelve Fellowships, with third-year extensions. The scheme is also not full-cost funded. We recommend that the Government review the cost basis of the Fellowships.**
1	**James Cook Administration**
6	**The national science medals demonstrate the Government's support for the best and the brightest. We recommend raising the profile of the Rutherford Medal, which is the national science medal, by associating it with a monetary award and more promotion**
6	**We recommend that MoRST support the Pickering Medal for technology**

5. Supporting the Profession

	MoRST Output Agreement 2005/6
7	**The global change to Open Access in the business model of journal publishing has placed heavy financial pressures on the journals. The Royal Society currently subsidises the Government-owned journals, but cannot sustain this. We recommend that the Government fully support the move to open access journals, beginning with phasing out subscriptions and phasing in page charges**
7	**There is clear interest in digitising back issues of the journals. This provides a cost-effective way for Government to maximise the impact of research that has already been paid for. We recommend that the Government continue to support the digitisation and access to journals at the current rate of one decade per year. This will be completed in two years**
8	**International Capacity building**
8	**Support for increasing international subscriptions and memberships**
5	**Grow International Science and Technology Linkages Fund 20 %pa**
1	**Additional ISAT Linkages Fund RCM**
3	**A new Fund to enable joint international basic research within Marsden**
1	**Joint International Basic Research Fund - Administration**
8	**Expand CoLab website**
6	**Support for Study of the Impact of Basic Research**
7	**Develop web interactivity for Alphas and Gammas and translation of one Alpha into Māori**

PART B – REPORTING ON OUR OUTPUTS FOR THE MINISTRY

RESEARCH CONTRACT MANAGEMENT

Output Class 1 – Research Contract Management (except Marsden) -

Research contract management activities will be described in the sections for the relevant activities. In summary, our recommendations are:

Output Class	Activity
6	TSSTA Management+Promotion
1	Management for short term Fellowships
1	Increase in contract management for Teacher Fellows to encourage applications from less-well represented teacher groups, more new hosts organisations for Teacher Fellows, and provide more support for the new hosts
2	There has been continuing growth of the Marsden Fund, an increased number of contracts, and a need for an executive with enhanced evaluation and policy analysis capacity. We recommend a step increase in the fee for administering the Fund. Plus an additional increase if the Fund is increased beyond its current level.
1	James Cook Administration
1	Joint International Basic Research Fund - Administration

MARSDEN FUND

Output Class 2 – Research Contract Management of the Marsden Fund
Output Class 3 – The Marsden Fund - $38,169,000 in 2005/6, inclusive of GST

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 significant contributor to the principles of the Growth and Innovation Framework by fostering innovation of the highest quality, developing people with skills and talent, and increasing global connectedness.

This year, the special nature of the Fund and the benefits it delivers to the research community and to society were highlighted by an independent evaluation of the Fund commissioned by MoRST.

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, is responsible to the Minister for establishing overall policy and operational principles. It also has responsibility for allocating funds to projects and overseeing the progress of the research and researchers. Executive support for the Marsden Fund Council is provided by the Royal Society operating under a Memorandum of Understanding agreed with the Council. The Fund is administered on behalf of the Council by The Royal Society operating under an agreed contract with MoRST. The Royal Society organise the selection process, manage the disbursement of funds, monitor progress, evaluate the outcomes from the research, and provide secretariat services to the Marsden Fund Council. The 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 2004/5, the Marsden Fund operated as a separate Output Class under the Knowledge Goal of the RS&T system, with an investment budget of $34.289 million inclusive of GST (20.6 % of the Knowledge Goal investment, 5.5 % of Vote: RS&T).

During the year, 384 research contracts were operational, covering the humanities, social sciences, sciences, mathematics, and engineering. $36.686 million (net of returned funds) was distributed to active contracts.

In the 2005 Budget, the Fund was allocated a further $2.88 million, which together a pre-announced increase of $1 million brought the size of the Fund to $38.17 million inclusive of GST.

The Marsden Fund Council believes the Fund should increase by a further $21.83 million over the next 3 years to $60 million per annum. This report makes that case based on the value the Fund delivers through its role in:

- building New Zealand's knowledge base;
- building human capacity, and
- enhancing global connectedness.

MAXIMISING THE FUND'S IMPACT

The independent review of the Fund concluded that:

- The kinds of investments that the Marsden Fund makes can be expected to produce high and positive social, cultural, and economic returns;
- Marsden's returns are most likely to be generated indirectly, such as from human resource development, or initiating new areas of discovery;
- New Zealand spends a comparatively low proportion of its GDP on non-oriented research. Since such research plays both an economic and a cultural role, there is a case for increasing national expenditure on it; and
- Marsden is funding a low proportion of proposals when compared with similar international funds and research councils. About 10 % or fewer of applications are successful, against an international benchmark of about 30 %.

The Marsden Fund Council and the Royal Society strongly endorse those conclusions. The Marsden Fund sets the standard in New Zealand for its portfolio of high quality research and for the rigour of the process 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 and to connecting New Zealand's research to the rest of the world. Later sections of this report describe this in more detail.

The most important issue the Fund faces is the ongoing effect of only being able to fund a very small proportion of the applications received (7.1 % in 2004) and the lost opportunity this represents in terms of new skills, new knowledge, and new research networks.

Interest in the Fund has remained at very high levels. The number of applications received in 2005 was the second highest in the Fund's 10 year history. The previously unsignalled increase in the 2005 Budget of $2.88 million per year will enable a greater proportion of the applications to be funded, however, it will not be sufficient to achieve the target success rate of 15 %, or even to return to the levels of the Fund's earlier years of 10 %. It is expected that 79 new projects will be funded in 2005, giving a success rate of 8.8 %. A concern is that with such a low success rate, the overall cost of applying for funding is becoming too great, preventing some of the best research ideas from coming forward.

In the application process, applications rated as "excellent" have been assessed to be in the top 10 % of proposals worldwide. Each of these proposals has met rigorous criteria, including international peer review. On that basis, the work proposed in each application can be expected to be highly beneficial for New Zealand. However, the small size of the Fund means that many of the "Excellent" proposals cannot be funded. Increasing the Fund to $60 million would allow all of these proposals to funded, whilst maintaining the remarkable quality of the research in the fund.

HIGHLIGHTS

HIGHLIGHTS - THE FIRST TEN YEARS

On the 10th anniversary of the Marsden Fund, it is appropriate to highlight some of the research during the first 10 years that symbolises the character of the Fund and its wider impact on research and society.

Some of New Zealand's **top researchers** have been strongly supported by the Fund, helping them to create leading-edge new knowledge, to build their careers and international reputations, and to foster the next generation.

In biological mathematics, for example, Professors Mike Steel and Mike Hendy have made outstanding contributions to the mathematical theory of phylogeny, particularly in the construction and analysis of evolutionary trees. More recently, they have been joined by Dr Charles Semple, currently a Senior Lecturer at Canterbury University, who has successively been a PhD student, postdoctoral fellow, and (twice) a principal investigator on Marsden projects. The performance of these three researchers has attracted at least one outstanding mathematician, Dr David Bryant, back to New Zealand, and to success in the 2005 funding round.

Theoretical biologist, Professor David Penny, has worked alongside these mathematicians developing theories and implementing practical methods that are used around the world. Penny's insights regularly feature in the popular press; one is his argument, pursued with funding from Marsden, that the dinosaurs were being eclipsed by mammals and birds millions of years prior to the meteorite impact 65 million years ago that finally finished them off.

The research of another of New Zealand's foremost scientists, Professor Paul Callaghan, has been consistently supported by Marsden over the last decade. Callaghan is an authority on nuclear magnetic resonance imaging, a technique in which the spins on atomic nuclei are tweaked and subsequently monitored, providing information on the position and movement of atoms. Marsden has supported investigations of the flow of soft materials, complementing FRST funding on other aspects of his work. The quality of this research not only enhances New Zealand's scientific reputation, but also feeds into industrial processes widely used in the dairy industry.

Professor Michael Walker has been funded to investigate the magnetic sense of trout and pigeons, which has led to 3 publications in Nature since 1997, the most recent of which has been selected by "Faculty of 1000" as one of the most important papers in biology. In these publications, Walker and his colleagues have demonstrated that the magnetic sense is based on very small crystals of the magnetic mineral, magnetite, in the nose or beak of the animal, and have identified the likely sensory pathway from there to the brain in homing pigeons. Also from measurements on homing pigeons, they have shown that these birds navigate by detecting changes in the strength of the Earth's magnetic field, systematically flying parallel and then perpendicular to the magnetic field. This work is a significant advance towards understanding the navigational feats of migratory animals. A practical spin-off is that the GPS techniques used will have wide applications in ecology and conservation, as they provide a means of monitoring wild animals at a small fraction of the current cost.

The Microlensing Observations in Astrophysics (MOA) collaboration typifies the strong **international collaborations** that arise from top quality research. MOA is a joint New Zealand-Japan astronomy project, centered on the Mt John Observatory, Lake Tekapo. Funded almost continuously since 1995, to the tune of $1.6 million, it has based its observations on the bending of light proposed by Einstein. Among its many successes is the detection of the most distant extra-solar planet ever seen, which was widely reported in worldwide media. While Marsden is one of the few domestic sources of funding for astronomy, the success of the programme has led the Japanese to invest in a new telescope at Mt. John, worth $7 million.

Another highly successful international collaboration is the Canterbury Ring Laser project, which has received similar funding to MOA. By sending laser light in both directions around a rectangular path defined by angled mirrors, tiny changes in the rotation of the Earth can be measured, culminating in the recent observation of a wobble in the Earth's axis of just 1 metre at the poles. Such measurements have practical value for geophysics and seismology, as well as fundamental aspects of physics. It is for this reason that Germany has collaborated strongly throughout the project and has recently completed the building of a $19 million ring laser in Bavaria.

Marsden is about improving our **understanding** of things that many of us take for granted. Why is it, for example, that leaves are sometimes red, and why does New Zealand have so few native deciduous trees? Dr Kevin Gould maintains that the red pigment in leaves – anthocyanins – protect the leaf in 3 ways: from excessive sunlight; reduction of the production of highly damaging free radicals; and the mopping up of free radicals. Dr Matt McGlone and his team has answered the second question: the temperate climate of New Zealand is such that neither evergreen nor deciduous trees are naturally favoured; rather, it is the poor soils in New Zealand which lead to evergreens – dropping leaves once every year is too wasteful when nutrients are in short supply.

Several fields have been perennial **high performers** in Marsden, including psychology. Two University of Otago child psychologists, Professor Harlene Hayne and Dr Elaine Reese, have each received several grants to study complementary aspects of cognitive development in children from the age of 3 months up. Professor Hayne has documented memory development in the same group of children from infancy through to childhood. This includes the reasons for why we all suffer from childhood amnesia, the inability to recall experiences from our infancy and early childhood. In parallel studies, factors influencing the onset of this autobiographical memory have been investigated by Dr Reese and found to be related to the child's sense of self. Parents can strongly influence this – those who converse with their children in a more reflective style help children to develop a better memory and a better understanding of themselves and others.

Another high performing area in Marsden is geology. This is aided by the fact that New Zealand is a superb natural laboratory in which to study earthquakes, volcanoes and plate tectonics. For example, by observing how seismic waves move through the ground around Mt Ruapehu before and after the 1995-1996 eruptions, Dr Martha Savage and her research team have discovered a technique which may predict when future eruptions may occur.

Important **new fields** have arisen since Marsden started. Geometric integration, a method of solving equations on computers, was invented by mathematician Professor Robert McLachlan and was developed with a Marsden grant. Bose-Einstein condensation, a phenomenon in which atoms effectively lose their individual identities at very low temperatures, was first achieved in the USA in 1995, and since then New Zealand physicists have been actively involved in this field with the support of Marsden. A major focus of research efforts, both here and abroad, has been the development of an atom laser, a device that emits a pure wave of matter.

Marsden contributes to **innovation**. Dr Ken McNatty and Dr Jennifer Juengel at AgResearch have received Marsden funding to investigate protein factors that may affect ovulation and fertility in mammals. Research from this programme has shown that ovulation can be regulated in sheep by immunising them against either of two protein factors. By adjusting the strength of the vaccine, the sheep either do not ovulate at all, or the ovulation increases. Therefore, these factors appear to be targets for modulating fertility in sheep. Five patents have been filed from this research.

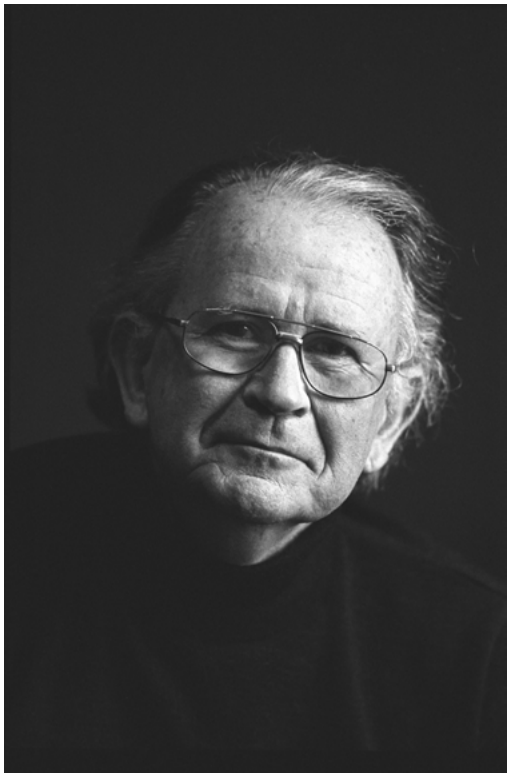
Professor Bill Denny at the University of Auckland's Cancer Society is leading a team which received Marsden funding to carry out fundamental work on prodrugs, chemicals which can selectively kill cancer cells but not affect neighbouring healthy cells. The team has synthesised a range of prodrugs consisting of various "trigger" groups, which are activated by various external factors such as low oxygen, and "biocide" groups which only become effective when activated. Their Marsden-funded project has led on to a patent application and further work funded by HRC and NERF. In the last year, Associate Professor Richard Blaikie has demonstrated a technique that can focus light tightly enough to improve the manufacture of silicon chips by making the individual components on the chip smaller. This has overcome the barrier to miniaturisation imposed by the wavelength of light, and has seen New Scientist (5 June 2005) place Blaikie on their timeline of "A Brief History of Negative Refraction", along with 10 other scientists including Descartes, Snell, and James Clerk Maxwell.

Marsden research has thrown up some **chance discoveries**. Professor Colin Green's group was studying the development of embryos when they accidentally discovered a way of preventing the spread of brain damage, following head injury. Their method is to limit the communication between cells by restricting the number of gap junctions, and they have subsequently found that this promotes wound healing in general. A company has been formed, discussions have been held with New Zealand Trade & Enterprise and Technology New Zealand, and commercial opportunities are being explored with overseas companies.

Although a key element of Marsden research is in the development of understanding, some projects do find **commercial application**. Sustained funding of a project to study extraterrestrial chemistry, requiring the development of a sensitive gas detector, has led to the formation of a company employing 27 people – Syft Technologies Ltd makes sensitive mass spectrometers which have numerous applications including medical diagnostics, environmental monitoring, biosecurity, explosives detection, and petroleum exploration. Nano Cluster Devices Ltd is another new company in which Marsden has played a part; initial work on the structure of atomic clusters was funded in the 1998 round.

Some projects, particularly in the social sciences, inform **policy** or **practice**. For instance, the Fast-Start research of economist Dr Ken Carlaw on how technological change drives economic growth, has drawn interest from researchers in the Ministry of Economic Development, the Reserve Bank, and Treasury. Educationalist, Dr Jude MacArthur, is currently tracking 11-13 year old disabled children and their non-disabled peers as they make the transition from primary to secondary school, to understand how factors relating to impairment, social relationships, school culture, ethos, and environment impact on children's personal identity. Findings so far have been shared with education researchers and teachers from New Zealand and Australia, principals, parents, professionals with an interest in disability issues, and civil servants.

In the environmental area, Marsden funding has been supporting Dr Stephen Wing in his investigations of the marine ecology of Fiordland, particularly food webs and the dispersal of marine organisms. Along with work funded by the Ministry for the Environment and the Ministry of Fisheries, this has directly informed a management strategy for the Fiordland area, which has become enshrined in law as the Fiordland (Te Moana o Atawhenua) Marine Management Act 2005. Also on the environmental front, Fast-Start researcher, Dr Darryl MacKenzie has developed a statistical model for the optimal sampling of wildlife populations. This will lead to improved management of threatened species throughout the world, and has already been applied to weta and amphibian populations in New Zealand. And a 1996 Marsden project, aimed at understanding the afternoon winds in the Mackenzie Basin has led, in the last year or two, to advice on regional wind patterns for electrical generation companies planning wind farms.



Humanities and social sciences provide a **cultural dimension** to the Marsden Fund. In linguistics, The Origins of New Zealand English project, which has received sustained funding, has used unique archival resources to trace the origins and development of New Zealand English. This is the only version of English for which recordings are available for its entire history. Using the Mobile Disc Unit archive of the New Zealand Broadcasting Service, and other sources, they have found that the "colonial twang" can be heard in people born as early as the 1870s, and that it emerged faster in areas where there was a mixture of people from different places. Using the same resource, the change in pronunciation in Māori over time is now being tracked. Marsden funding has also led to some highly-praised biographies. The Book of Iris: a Life of Robin Hyde by Derek Challis and Gloria Rawlinson, was a finalist in the Montana New Zealand Book Awards in 2003. The following year, Long Journey to the Border: a Life of John Mulgan by Vincent O'Sullivan, was also a finalist. Even better, The Trial of the Cannibal Dog: Captain Cook in the South Seas by Dame Anne Salmond, won the 2004 Montana Medal for Non-Fiction, with the judges saying that "Salmond is a consummate storyteller and this book, as well as being in the very first rank of historical scholarship, is quite riveting." As implied by the title of Salmond's book, the lives of humans are intimately connected with those of other animals, and this connection provides an example of the **new insights** that are being achieved through the Fund. Humanities researchers, Drs Philip Armstrong, Annie Potts, and Deidre Brown have just this year started to explore "The Animal in Culture in Aotearoa New Zealand", Māori and Pakeha understandings of animals and human-animal relations as they are expressed in the visual arts, literature, popular media, and everyday life.

PROGRESS AND ACHIEVEMENTS EVALUATION

IMPACT

The recent independent evaluation recognised the following features of the Fund, on the basis of international evidence, to be positive indicators of the Fund's impact:

- an increasing proportion of Marsden funded projects appear to lead to new scientific collaborations;
- more than half the Marsden recipients who have been surveyed before or during Webresearch's research, report their own and their group's capabilities have been enhanced by the Marsden grant. The proportion for whom this is so appears to be increasing, and for a significant number this is the most important side effect of receiving a Marsden grant; and
- most Marsden recipients find that a Marsden grant enhances their reputation.

In addition, the MoRST evaluation, carried out by Web Research/Technopolis, found that "a notable proportion of Marsden funded projects appear to establish a new research direction that subsequently attracts other funding sources". It is a major positive benefit to the research environment in New Zealand. It is interesting to note that slightly more than a third of project leaders on NERF contracts have been, or are currently, PIs on Marsden contracts.

> *"Marsden funding has sparked an entirely new research direction for the group. Our previous work has drifted away as it has become replaced by this more dynamic research programme"*
>
> *"The Marsden Fund is an essential source of major funding for the basic sciences. Our grant allowed us to pursue an intensive and productive series of brain science investigations that would not otherwise have been possible. The research activity and research momentum fostered*

> *by this grant has had a clearly beneficial effect on our research capabilities and research environment, and has provided important momentum for the future development of our Research Centre for Cognitive Neuroscience"*

BUILDING NEW ZEALAND'S KNOWLEDGE BASE

The Fund's contribution to building New Zealand's knowledge base can be assessed by the scope, quality, and productivity of Marsden-funded research and researchers.

Scope

Marsden research covers a full range of disciplines. By being investigator-initiated, the only limits on the Fund's scope are the interests of the research community. This is shown by the range of topics in the Highlights section.

Quality

The quality of Marsden contracts is maintained, in part, by the peer review process used to help select proposals for funding. The Fund aims to have each proposal refereed by at least 3 specialists, almost all of whom are from overseas. This ensures that only proposals meeting high international standards are funded.

In the 2004/5 round, 90 % of the referees used were international, from a total of 27 countries. As a consequence, funders and applicants can be confident that the chosen research is world class. In fact, in the last three funding rounds, ~65 % of the proposals reaching the second stage were judged as being in the top 10 % of all proposals that the referees had reviewed for all funding agencies (see Appendix 5, Figure 20). However, only 37 % in the 2004 round and 38 % in the 2005 round were able to be funded.

Bibliometric analysis has shown that articles arising from Marsden projects are typically cited 1.7 times more often than the average for NZ-authored articles[1]. As commented in the recent external evaluation of the Fund:

> *"Publication and citation rates can be regarded as a proxy measure of research productivity. If this is so then the RSNZ's bibliometric studies indicate that the Marsden Fund is succeeding in this objective [enhancing the underpinning knowledge base in New Zealand], and outperforming the New Zealand science system as a whole in doing so" – para 77, Report of the evaluation of the impacts of the Marsden Fund 2005*

Contracts that have reported during 2004/5 have resulted in numerous publications in prestigious journals, including articles in *Science*, *Nature*, the *Proceedings of the National Academy of Sciences*, and the *Public Library of Science Biology*. These are described in Appendix 2.

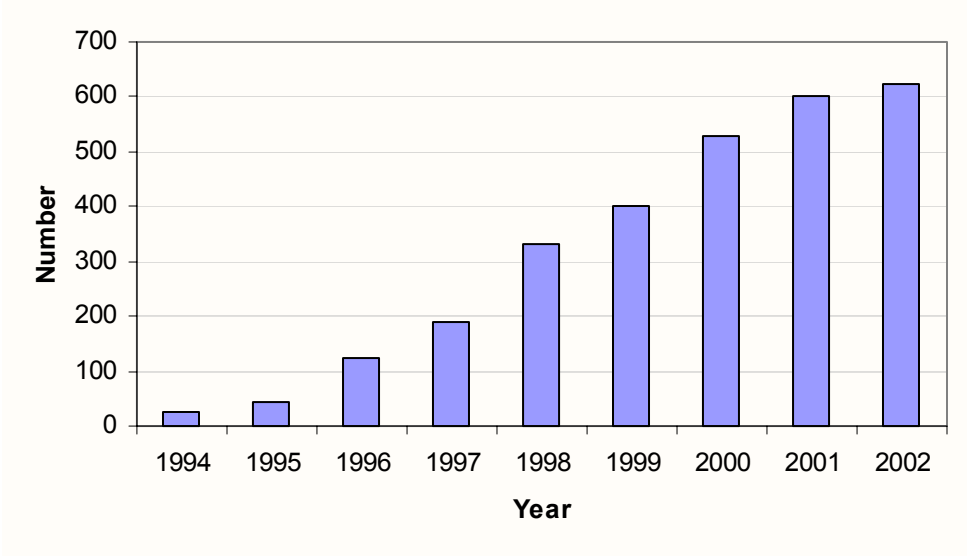
> *"The work should attract considerable interest from the plant science community and I am confident it will find its way into plant physiology textbooks as a clear experimental demonstration of Munch pressure flow. The authors are to be congratulated on a completing an excellent piece of work". Anonymous journal reviewer*

Productivity

As previously reported, a bibliometric analysis of the number and type of New Zealand publications from 1994-2001 revealed that the annual number of publications attributable to the Marsden Fund has increased steadily in that time, with Marsden contributing 7.7 % of all New Zealand research publications in 2001, despite only representing 2.5 % of New Zealand's gross expenditure on research and development. Publication figures for 2002 and 2003 are still being compiled as the relevant contracts finish; however, the indications are that the trend of increasing numbers of publications is being maintained (see Figure 1).

[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

Figure 1. Number of publications per year funded by Marsden.



In comparison with other New Zealand schemes, the Marsden Fund produces a high number of articles per dollar spent. From 2000–2002, the Marsden Fund has consistently produced between 14–16 peer-reviewed articles and books per $million awarded each year. For comparison, NERF and ENV funding produces 8 peer-reviewed articles per $million, and RFI funding produces 6 articles per $million[2] and the NZ average is 6 articles per $million of GovERD and HERD in 2000[3]. By this measure, Marsden has twice the productivity of other funding schemes.

BUILDING HUMAN CAPACITY

The Marsden Fund has played a significant role in the New Zealand research environment. The Fast-Start award scheme has enabled emerging researchers to build their careers. The Fund provides support for many postdoctoral researchers and provides substantial opportunities for postgraduate research training. (See Appendix 3 for numbers.)

The impact that the Fund has had on researchers is illustrated by comments volunteered during site visits:

[2] FRST "Outcome Indicators 2003–04" http://www.frst.govt.nz/evaluation/downloads/outcome/2004-09-23_Outcome_Indicators_2003-04.doc
NERF – New Economy Research Fund; ENV – Environment Output Class; RFI – Research for Industry

[3] GovERD – NZ Government expenditure on R&D; HERD – Higher education expenditure on R&D

"Ours was the first Marsden grant in the Department, which encouraged two other staff members to apply successfully. It allowed me to 'buy' a team and was great for leveraging other money to fund Masters students and postdoctoral fellows"

"There is no doubt that securing a Marsden project and the opportunities it provides is a significant boost to morale and to scientific recognition and credibility. Moreover, the achievements made through the Marsden project have provided excellent international exposure and recognition through scientific publication and publicity"

"This grant has been transformative - a huge boost to our credibility. It has freed us from funding constraints and we are considering setting up a new Research Centre if we can gain sponsorship"

"The Marsden Fund was the only body that would have provided this opportunity and without it, it is questionable whether we would exist as a robust and respected research group."

PEOPLE SUPPORTED BY MARSDEN

Prizes and awards bestowed on Marsden researchers in 2004/5 include appointment to the NZ Order of Merit; election to the Fellowship of the Royal Society of New Zealand; Rutherford, Pickering, and Marsden Medals, and the Ampère Prize amongst others (see Appendix 5, Table 13).

The Marsden Fund provides strong support for new and emerging researchers, as demonstrated by the large percentage of projects featuring Principal Investigators (PIs), and Associate Investigators (AIs), early in their research careers, as well postdoctoral fellows and postgraduate students. The 2004/5 funding round saw a continuation in the trend to younger PIs, with 48 % of contracted PIs being within 10 years of gaining their highest degree (in most cases a PhD), compared with 27% in 2000/1 and an estimated 17 % in the NZ research community.

The percentage of PIs who are women has grown steadily from the Fund's inception, when it was 6 %, to the current 26 %. This level of involvement of women researchers is an accurate reflection of the proportion of applications received from this group. The 2004/5 round also saw an increase in the number of Māori researchers. However as the absolute numbers remain low, there may be large fluctuations in the percentage from one year to the next.

Appendix 3 – "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. These surveys also suggested that the Fund had aided 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.

"We might not be here if it wasn't for Marsden, the grant has been very important in this respect"

"My group would not exist without Marsden funding. It is a worry as to how we will continue once funding ceases"

Despite this evidence, some commentators have expressed scepticism that Marsden can play a significant role in encouraging and retaining talent in the New Zealand research system, given the small size of the Fund and the low number of researchers that it can support each year. While reservations about this role for the Fund may be justified on these grounds, another belief, that much of what Marsden funds could have gained funding from other extant sources, is challenged by the Marsden research community:

> *"This research could not have been undertaken without Marsden funding. Some of the work may have been undertaken overseas by others over the next several decades"*
>
> *"In New Zealand the only place to secure funding for research of this kind is the Marsden Fund; outside of this source funding opportunities are very limited. We have explored other options, but due to the cross disciplinary nature of the research it has been difficult to identify and secure further alternative funding to extend this work. Personally, I think the Marsden Fund is invaluable in promoting opportunities for funding excellent science and scientists" – this contract led to a paper in Science*

In a more quantitative fashion, following the completion of their projects Marsden investigators have been asked whether they believed the project would have occurred without the Fund's support. From 2003–2005, 82 % of PIs agreed that Marsden "enabled research that would not have been possible otherwise" while the remaining 18 % were of the opinion that their contract had "sped up" their research. For this latter group, the estimated time gained was in the range of years to decades and often they believed that in the absence of Marsden funding the research advantage would have been lost to groups outside New Zealand.

ENHANCING GLOBAL CONNECTEDNESS

International Collaboration

The Marsden Fund is associated with a high, and growing, level of international collaboration. Marsden research is of global significance and, as a consequence, attracts and supports overseas collaboration.

The 2004/5 round represents the highest to date in terms of contracts involving international collaboration at their inception (41 %). In addition to the contracts with international principal and associate investigators, many more develop international links during the course of the project due to the significance of the research and the opportunities Marsden offers to present the work internationally (see Appendix 4, Table 10). As a consequence, the majority of projects have developed international collaborations by their completion (84 % for projects that finished in 2004/5).

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

The benefits of international collaboration are listed in Appendix 4 – "Enhancing Global Connectedness".

Some examples of feedback received from recipients are given below.

> *"My contract led to ongoing collaboration with NASA, UCLA, Northwestern University, Caltech, and Kyushu"*
>
> *"Sabbatical time has been spent in UK and Australian labs furthering the work of this contract. In addition links have been formed with the New Orleans lab, which houses an ex-PhD student, and a group in Milan. All these connection were formed on the strength of the Marsden contract, are strong (involving material, personnel, and skill transfers), and all are 5-years+ and ongoing"*

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. (Appendix 4, Figure 19)

FUTURE DEVELOPMENT OF THE FUND

The Marsden Fund makes a substantial contribution to the research environment in New Zealand as demonstrated in the previous sections and the recent MoRST review. The Council continues to seek ways to further develop the

Fund to maximise its benefit to New Zealand and to the research community. The Council has identified key issues facing the Fund as:

- the increased interest in the Fund;
- the large number of high quality proposals not funded;
- the extent to which young and emerging researchers can be supported;
- the perceived overlap with other funding mechanisms; and
- the increased pressure on administration and support services provided for the Fund by the Royal Society.

Priority needs to be given to increasing the size of the Fund to:

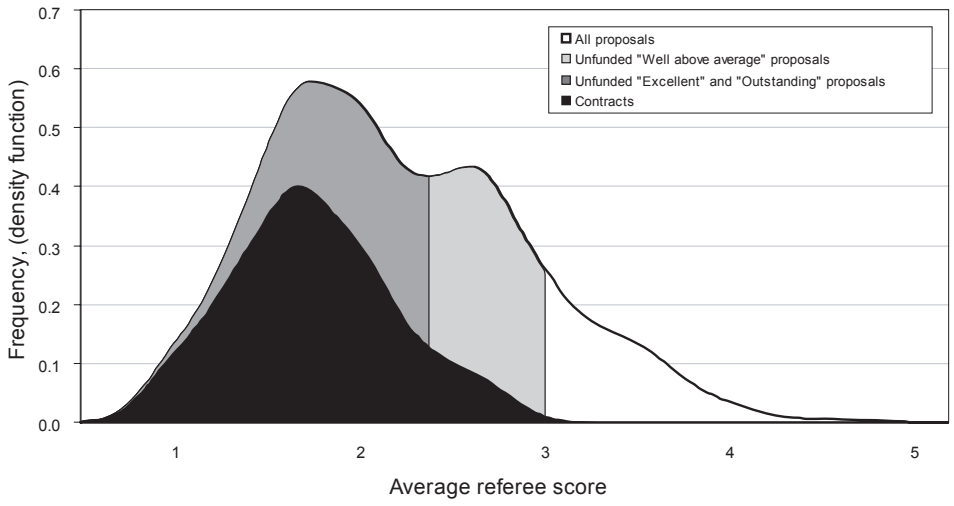
- fund more high quality research;
- broaden the scope of Fast-Start awards; and
- pursue opportunities for co-funding with overseas funding agencies.

FUNDING MORE HIGH QUALITY RESEARCH

The Marsden Fund Council believes that there is substantial scope for increasing the Fund's delivery of its objectives by increasing the number of awards made. The MoRST review of the Fund noted the very low success rate for applicants (currently 7 to 8 %) compared with the international norm for similar funds of circa 30 %.

Figure 2. The distribution of referee scores for both funded and unfunded proposals to the 2003–2005 funding rounds.

Scores equate to: 1 = "Outstanding – among the top 5 % of proposals worldwide"; 2 = "Excellent – among the top 10 % of proposals worldwide"; 3 = "well above average, top 20 %"; 4 = "above average"; and 5 = "average or below average".



There is strong evidence that if the size of the Fund was more than doubled to $80 million per annum, that it would still be possible to select only the highest quality projects to fund (analysis discussed further in Appendix 5). At this level, only proposals considered by international reviewers to be among the top 20 % worldwide would be being funded.

The Marsden Fund Council is conscious of the need to balance the prestige of receiving an award against expanding access to funding, but it is also conscious that the Marsden Fund sets the standard for excellence in the research

community. So, their recommendation is for the Fund to support all of the "Excellent" and "Outstanding" proposals, requiring an increase the Fund to at least $60 million per annum and to spread the financial impact of the expansion of the Fund over the next 3 years.

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. It would also have the effect of boosting the confidence of the research community, some of whom are deterred from submitting their best research ideas because of the low success rates historically for applications to the Fund.

BUILDING HUMAN CAPABILITY

Increasing the overall size of the Fund will in general terms improve opportunities for a wide spectrum of researchers. However because of the high level of support given in Marsden projects to the development of new skills and to supporting postdoctoral and postgraduate research, the increase will particularly benefit younger researchers (Appendix 3, Figure 16 and Figure 17) shows the age distribution of Marsden recipients from past years.

In addition, Marsden Fast-Start awards are used to kick-start the careers of promising young researchers. The scheme has been now been running since 2001 and 91 individuals have been supported. The grant is sufficient to allow the researchers two years of funding for their own personal research programme; they are deliberately not large enough to provide for the hiring of other research staff, as the intention is that the researcher carries out their research themselves.

Supporting 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 practice so that they can compete with the track records of more experienced researchers.

Part of the requested increase of $21.83 million over the next 3 years will be used to increase the number of Fast-Start awards made and also to increase their value. These are fixed sum awards and their value has been eroded by price increases experienced in the 2004 funding round.

ENHANCING GLOBAL CONNECTEDNESS

An already strong feature of the Marsden Fund is the contribution it makes to global connectedness. Appendix 4 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 was expected, as the executing arm of the Fund, to undertake more policy analysis and provide advice to the Marsden Fund Council. This has not been possible as previous requests for an increase to the Research Management Fee have been declined and the greater priority on the use of the existing fee has been to operate the annual funding round.

Additional secretariat workload

In the five years since 2000/1, the monetary value of the Fund has increased in size from $25.8 million to $38.2 million (48 %). The number of proposals being handled has increased from 756 to 972 in 2004 (28 %) and the number of contracts being administered has grown from 336 to more than 400 (20 %). 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). Also, it has been necessary to increase the number of panellists used to assess proposals from 51 in 2000 to 61 in 2005.

However, during the same period, while the Marsden Fund Council's expectations in terms of service delivery had grown, the annual research management fee was changed. But much of the increase was to pay the increased honoraria level set by MoRST for the new Council members, so the effective increase for Royal Society operations has been 15 %, barely sufficient to cover 12 %[4] inflationary increases, let alone to fund the additional workload caused by administering a larger Fund with more proposals and more contracts or the increased secretariat requirements of the Marsden Fund Council. As a consequence, the Royal Society has had to reduce the secretariat staffing levels, placing in jeopardy their ability to maintain the high standard of application evaluation, research contract monitoring and fund evaluation and promotion. Fund promotion activities have also had to be severely curtailed.

Additional Social Sciences panel

In addition, it will be necessary to expand the proposal assessment activities from the beginning of the 2006 funding round because of the substantial growth in proposals from the social sciences. In 2001, social science awards represented 9 % of the value of all awards. In 2005 they were 16 %. A second social sciences panel will be established from 2006 to handle the volume of work at some cost.

Keeping Honoraria Realistic

It has also become desirable to increase the honorarium paid to members of the Assessment panels. It was last increased in 2001 but since then, the workload for individual panellists has increased considerably with more proposals to assess and increased participation in identifying suitable referees. The workload for a panellist is at least 10 working days per year in addition to attending the two day-long meetings.

Table 3 summarises the state of the Marsden Fund in recent years. The table also shows the fee paid to the Royal Society to administer the Fund.

Table 3. Growth of the Marsden Fund.

	2000/1	2001/2	2002/3	2003/4	2004/5	2005/6	2006/7 estimated
Fund Size	$25.8 M	$27.8 M	$30.8 M	$32.8 M	$34.3 M	$38.2 M	$38.2 M
Applications							
Preliminary	756	884	801	741	972	897	
Full	136	179	165	171	194	206	
New Contracts awarded	73	82	86	105	71	79	
Active Contracts	336	356	365	395	384	400 *	

* These figures are based on the current (2005/6) Fund size. An additional increase to the fee will be needed if the Fund were to grow further.

The Marsden Fund Council is therefore seeking a step increase to the fee to:

[4] Calculated using the decline in purchasing power from RBNZ CPI data from 2000 to 2005.

- raise the standard of policy analysis and advice provided to it;
- establish a second social sciences panel;
- increase the remuneration of the panellists;
- expand the research assessment capability by 1 FTE;
- increase awareness of the Fund's research portfolio and impact; and
- compensate for other increased operating costs as a consequence of the increased number of proposals and contracts being administered

The nature of the Marsden Fund, with its emphasis on peer review, progress monitoring and evaluation, means that an ongoing increase in the management fee to match the extra workload generated by any future increases to the Fund is essential.

It is recommended that in future, the research management fee be reassessed whenever there is an increase to the Fund or a change in performance expectations. For the reasons given above, the fee needs to be at a significantly higher rate than at present.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

There are two main elements to the future investment recommendations. These are:

1. Enabling more research
Enlarging the Fund by $21.83 million over 3 years to $60 million per annum in order to increase the quantity of high quality research undertaken and, as a consequence:

- expand the knowledge base in New Zealand;
- expand and broaden research skills in New Zealand; and
- increase the global connectedness of New Zealand research.

2. Increasing the fee for administering the Fund
This would provide for:

- the additional workload generated by 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.

With the recommended funding increases it would be possible to expand 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 some of New Zealand's best research ideas and people. It performs extraordinarily well in terms of the productivity of the researchers and the quality of the research undertaken. However, New Zealand misses out on many outstanding and excellent projects which could be supported without lowering the high standards of the Fund.

The importance of increasing the fee for the fund administration activities has been described in this Marsden Fund chapter. Essentially, a $38 million fund is delivered by five staff with some minor casual administrative support - more efficiently than similar-sized funds in New Zealand. The small increases in the administration fee received in the last 5 years have not kept pace with the growth in the Fund that has occurred every year in the same period. The Marsden Fund Council and the Royal Society recommend an increase in the administrative fee. This higher level would recognise the additional administrative load that has been caused by the increase in the number of applications to be handled, the number of contracts to be managed and the introduction of the Fast-Start awards. 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;
- increasing the honorarium paid to panellists;
- 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.

JAMES COOK RESEARCH FELLOWSHIPS

Output Class 4 – Supporting Promising Individuals - $720,000 in 2005/6, inclusive of GST

James Cook Fellowships are more than an order of magnitude more productive than the Vote RS&T average, by scientific productivity per research investment.

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, and then re-instated under Royal Society administration in 1996.

The Fellowships allow our best researchers uninterrupted time to concentrate on their research. The Fellowships allow for two years of dedicated research, unconstrained by administrative and teaching loads. This allows Fellows to focus a lifetime of study and scholarship on issues that advance New Zealand's role in knowledge creation. For most, the two years have been totally transformative and have led to some impressive achievements (see highlights below).

The James Cook Research Fellowships are awarded, as funding permits, in:

- Biological sciences (including biotechnology);
- Engineering sciences and technologies.
- Health sciences;
- Physical sciences (including chemistry, geosciences, mathematical and information sciences);
- Research of relevance to the peoples of New Zealand and/or the Southwest Pacific; and
- Social sciences.

The Fellowships are offered in rotation among the disciplines, with two or three awarded each a year. The active James Cook Research Fellowships during 2004/5 are listed in Appendix 8. There was a Call for Applications in Physical Sciences, and Engineering and Technologies Sciences in early 2005 for a start in March 2006.

Currently, the fund provides for two years of dedicated research for at least 5 fellows at any one time. The Fellowship can be extended to three years depending on the outcome of a review after the initial two-year period. However, funding levels are now insufficient to offer extensions to all those eligible. Insufficient funds meant no third-year extensions were granted in 2004 and funding was available for only one in 2005.

The size of the Fund has not increased since 1998, funding provided by MoRST has remained at $720,000, a fall in real terms of 19 %. The annual stipend was increased in 2004 to $110,000 to partially restore the eroded buying power and to enable Fellows to spend some time overseas which has been very valuable. However, without increased funding, accommodating the increased stipend meant reducing the number of Fellows from six to five. Unfortunately, this means that researchers in some disciplines will have to wait three years for an opportunity to apply.

HIGHLIGHTS

Three Fellows finished their Fellowships within the 2004/2005 period; one Fellow requested and was granted a third-year extension. The results of one who finished, and one who was granted an extension, are highlighted below.

Associate Professor Andrew Pullan, University of Auckland, had a fellowship from 1 July 2003 to 30 June 2005. He was granted a third-year extension until June 2006.

> *"The Fellowship has provided me with the most valuable commodity of all—time. This has been the longest stint of unencumbered research time that I have had since my PhD..... The last 6 months have been the hardest I have ever worked in my life."*

Professor Pullan's tenure has been very productive with 16 refereed papers published or in press, 17 refereed conference papers published, 23 other conference presentations/abstracts delivered and one book completed.

Professor Pullan's Fellowship had two primary research objectives. The first was to advance the development of a computational modelling framework that can be used to integrate the physiological, anatomical and medical knowledge of the bioelectric activity of human organs, with a significant focus on the gastrointestinal (GI) system. The second objective was to focus this framework on diseases of the GI tract with the aim of linking the underlying mechanisms associated with the diseases to non-invasive magnetic and electrical recordings.

His research has now matured to a point where he and his team can apply the modelling work to quantitatively analyse real patient data and thus seek to clinically validate his efforts. As a result of the modelling work that he has been doing, two new projects have begun with Auckland-based clinicians.

Dr Mike Berridge, Malaghan Institute, finished his two-year Fellowship in June 2004.

> *"One of the benefits of the Fellowship scheme is that it allows academic freedom to explore boundaries that are not usually a feature of outcome-driven research."*

His research has uncovered a specific pathway that cells use to de-stress themselves. The pathway is used to transport electrons across the lipid membrane surrounding the cell, to neutralise the build-up of stress-causing molecules within the cell. In cancer cells, this pathway is altered, providing an opportunity to develop drugs that specifically target cancer cells, with few side-effects.

During his tenure Dr Berridge published 6 papers with 3 others in press. He collaborated with New Zealand researchers at the University of Otago , NIWA and Crop & Food Ltd, and overseas with researchers from the University of New South Wales and Duke University, North Carolina.

EVALUATION

PRODUCTIVITY OF JAMES COOK FELLOWS

Three James Cook Research Fellowships due to complete in 2004/5 have published 36 papers and 1 book. The cost of these four Fellowships was $800,000 incl. GST, making these Fellowships more than twenty times more productive than the average New Zealand researcher[5].

One Fellow's research has drawn huge media interest with 28 radio interviews and print articles providing public awareness and education.

Another Fellow, in Social Sciences, has participated as presenter in four television documentaries which feature his JCF research. These will have international audiences of millions, being screened on Discovery Channel, National Geographic Channel, the PBS in America, and ITV in the United Kingdom.

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[5] 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

JAMES COOK FELLOWSHIPS – AGE OF FELLOWS, DISCIPLINE, COLLABORATION AND TRAINING OUTCOMES

The age of fellows, discipline, collaboration and training outcomes of James Cook Fellowships are described in Appendix 8.

LENGTH OF TENURE AND THIRD YEAR EXTENSIONS

Since the Fellowship was reinstated in 1996, we have only had the resources to fund six third-year extensions out of twenty-nine Fellowships. Two who have finished their extensions are highlighted below.

Professor Gaven Martin, University of Auckland, researched two fundamental areas of mathematics, nonlinear analysis and geometry. The third-year extension allowed him to double the output of his Fellowship, finishing three research monographs, publishing five papers and having another five accepted for publication.

Professor Jeff Tallon, Industrial Research Ltd and Victoria University of Wellington, discovered an entirely new class of high temperature superconductive hybrid materials with unprecedented properties early in his James Cook research. He used the third year to carry out critical and systematic investigations while he still had a lead on competitors. Under his Fellowship, Professor Tallon completed 54 scientific papers (30 of these in the third year), two patent applications and lectured on his work in ten countries. The potential range of applications arising from his research is enormous.

Without additional funding, it looks unlikely that any third extensions can be offered with certainty in the future.

The impact of the James Cook scheme could be greatly improved by enabling third-year extensions for all applicants, or offering three-year tenures for all. Full cost funding should also be considered because Fellows are only allocated a maximum of $10,000 per year for travel and direct costs associated with the Fellowship.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

The James Cook Research Fellowships demonstrate that enabling our best researchers to undertake research and analysis of international stature provides a massive return on Government investment in people.

- The remarkably high productivity of the Fellowships makes the James Cook scheme very cost effective.
- The Fellowships provide 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, PhD students and 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 for research excellence by the award of a Fellowship. The research undertaken maintains international credibility and standards. This is important for maintaining standards of universities in New Zealand and for the reputation of the individual researcher.

BUDGET

Restoring the Sixth Fellowship
The Terms of Reference state that at least five Fellowships should be in operation at any one time. The actual number was reduced two years ago from six to five, and extensions are often declined because of insufficient funds, despite the third years being the most productive. The scheme has not received an increase in funding since it was reinstated 10 years ago. The optimal number of fellowships, considering the current subject areas, should have

remained at six. This allows all of the subjects to be offered every two years. It is important to maintain the prestige of these fellowships, while enabling equality of access among researchers.

Restoring third-year extensions
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. Two-year tenures are considered too short and international comparisons show that tenures of up to five years are considered the normal benchmark.

We recommend an increase in funding to the scheme to allow reinstatement of a sixth Fellowship, and a negotiable third-year extension for all or an increase in the tenure of all fellowships to 3 years.

Full-cost funding
Stipends are not full cost funded. This means that some Fellows are subsidised by their institutions. If the Government funding were doubled to enable cover of 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/institutions with particularly healthy cash-flows. Full cost funding would also line the Fellowship up with other research funding streams in New Zealand. The cost of fully cost funding the Fellowships would vary by institution. As the Society does not determine this, we can make no dollar figure recommendation, but we raise this as an issue for MoRST's consideration.

Expanding this highly-productive scheme
The high productivity of the Fellowships and the high quality of the unsuccessful applicants suggests that increases to the size of the scheme would be very beneficial. We recommend a doubling of the original scheme, allowing for twelve Fellows at any one time, with the allocation to subject areas dependant upon the quality of the applicants.

SCIENCE, MATHEMATICS, AND TECHNOLOGY TEACHER FELLOWSHIPS

Output Class 4 – Supporting Promising Individuals - $4,061,000 in 2005/6, inclusive of GST

Teacher Fellowships involve teachers in the practise of science, giving them a wider view of research and technology and helping them in their teaching practise.

OVERVIEW

The New Zealand Science Mathematics and Technology Teacher Fellowships provide primary and secondary teachers of the sciences, mathematics, social sciences and technology the opportunity to improve their teaching through experience in technological or scientific practice. During their fellowship, teachers are able to fully immerse themselves in the discovery of knowledge or the transformation of it into useful products or systems. They become more skilled in the communication of science and technology. In the past 11 years, the scheme has allowed 405 teachers to refresh and reflect and return to the classroom and their students rejuvenated and inspired[67]. They pass that inspiration and enthusiasm on to their students.

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 teachers' increased knowledge and skills, the renewed enthusiasm of the teachers, their contributions to students and colleagues, and the widening of their horizons through being removed from the school environment and exposed to the practice of research and technology.

The scheme supports the retention of teachers in teaching and the wider education arena. It enables enhanced and innovative contributions to teaching and learning. Several teachers have reported that the opportunity offered by the Teacher Fellowship has ensured that they will remain in teaching rather than leaving in the immediate future.

> *"The Fellowship certainly extended my time teaching by a number of years."*
>
> Dawn Laurence, Wairoa College

> *"It was interesting to experience the gradual realisation that teaching is the area that I have both strengths and experience and to start looking forward to returning to the classroom."*
>
> Peter Sutton, Marlborough Boys' College

[6] Jordan, S and Galt, N: 1999, Science and Technology Teacher Fellow Evaluation, University of Canterbury

[7] Spratt, P and Knox, A, 2003; Enhancing understanding through practice, Proceedings 3rd World Conference on Science and Technology Education

HIGHLIGHTS

Teacher Fellows report that their Fellowship has a positive effect on their teaching. The most frequent response is that it has allowed them to gain a wider perspective on research and technological practice, and on the careers and study pathways 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 school community.

> *"Some of the value of the year has been the contacts made through associating and working with different groups and organisations. This networking is often not possible within the constraints of the school timetable and the contacts I have made will be of great value when I return to the classroom. On top of this is the large amount of resource material that I have accumulated directly and indirectly from my programme of work."*

Peter Sutton, Marlborough Boys' College

Mathematics teacher Vicky Binedell has a keen interest in whales and dolphins and has been involved in whale and dolphin conservation organisations as a volunteer for over two decades. Her fellowship year allowed her to bring two of her great interests together: to analyse data in order to understand the events that lead up to the stranding behaviour of marine mammals and then develop a mathematical model that would explain the phenomenon of marine mammal strandings.

"This started as a very daunting task as I very quickly realized that though I had some experience in stats and have been teaching maths and stats for over two decades, I still did not know enough to do this task properly. I set about finding ways to improve my knowledge. Lectures in Multivariate analysis and Markov chains soon helped me on my way. The professional development side of the year has been huge and varied. This includes learning new things in statistics that I had not done before, software programs, data collection, necropsies, being involved with people who are finding out new things about whales and dolphins and of course, learning about the rigors of academic writing …... and these are just a few of the things I have learned….. Wonderful, varied, mindblowing, mindgrowing, unexpected! How can I be brief about such an exceptional year?"

"I think that the scheme is a gift and so worthwhile. I think it works well and so I don't have any suggestions for the scheme itself - only that I trust that it will continue into the future so that more and more teachers will be able to be refreshed and re-energised! To say that my learning curve has been exponential would be an underestimate of how much I have learned!"

"I will be returning to St Cuthbert's College to resume my teaching career. I am excited about stats and want encourage my students to pursue stats as a career option."

Some of our highlights for 2004 included:

- The discovery of fossil vertebrate remains (yet to be identified) in Eocene strata in Northland;
- Development of live-time monitoring of the Kaikorai Stream;
- Clarification of the systematics of the weta family;
- Development of a new fire fighter's outfit;
- Development of a website on the Taranaki National Park;
- Restoration on Blumine Island and Queen Charlotte Walking Track monitoring; and
- The winning of YHA Conservationist and Tasman District Council Environment Awards by Ngatimoti School under guidance from a Teacher Fellow
- the prevention of frost damage in olives;
- the harrier hawk in Canterbury;
- walnut blight;
- the role of Islam in New Zealand; and
- determining that the Waiarohia Stream is a health hazard
- A marine resource for schools, Nga tamariki a Tangaroa, profiling marine creatures at Mimiwhangata;
- Greatly improved ICT skills by all Teacher Fellows;
- Selection of material suitable for student use;
- Learning GIS techniques and applications of these;
- Devising searchable digital inventories of materials for teacher and student use;
- Gaining understanding of planning processes used by local authorities;
- Compilation of activities that could be used on ecology trails for children/public; and
- Reflection on teaching practice and follow up on the ideas and teaching strategies for which a teacher normally wouldn't have the opportunity.

> *"With the shortage of qualified, experienced and capable science teachers in NZ, this scheme is an excellent opportunity for science teachers to upgrade, refresh and contribute more to the teaching profession. This scheme is an excellent opportunity for teachers to renew their passion for teaching and learning."*
>
> Barry Hennig, Flaxmere College

THE VALUE WE ADD

We have modified our monitoring procedures this year, and surveyed Teacher Fellows and hosts not visited by the end of March. The feedback was used to identify issues and follow these up in a strategic fashion.

Regional meetings have been strongly encouraged – this was a highlight in Canterbury where Teacher Fellows organised a monthly lunch-time meeting usually at one of their hosts. This concept is slowly spreading but is often dependent on the enthusiasm of key individuals; it would be helpful if we had sufficient time to enable this to be more widely organised.

HOST COMMENT:

> *"An excellent initiative that pays dividends to the deserving candidates, the organizations they are associated with, but more importantly, their students as they transfer experiences with passion, and in a leveraged way (i.e. to an entire class)."*

Regarding the benefits for a host:

> *"Perhaps indirectly, providing me with a few more students for employment tomorrow than would have otherwise been without exposure to the excitement of the work we are doing and…….. is uncovering"*
>
> *"……. has an unbiased view-point and is able to give useful feedback for our activities, and perspective since he understands our technologies, and what we are trying to do with them"*

EVALUATION

Appendix 9 describes the changes in the scope and scale, and distribution of the Teacher Fellowship scheme. The number of awards has risen to 64 in 2006. The majority of teachers come from high decile schools and this is a matter of concern. The gender distribution now closely reflects the gender distribution within the teaching sector and we continue to have difficulty in engaging non-European teachers in Teacher Fellowships.

PROFESSIONAL DEVELOPMENT OUTCOMES

Teacher Fellows continue to report positively on the effect that their project has on their teaching, particularly that they have been able to gain a wider perspective on research and technological practice, and on the careers and vocations available in these areas.

> *"I have had an absolutely fantastic year; so many opportunities, so little time. It has been particularly useful to have 'networked' extensively; building relationships with many people in various science/environment related organisations across the community. Professionally these will stand me in good stead as experts and role models for my students in the years to come."*
>
> Stacey Rod, St Margaret's School

> *"My scientific knowledge and experimental procedures have skyrocketed. Having the opportunity to learn rather than teach has been an experience that has been personally satisfying. Having the opportunity and time to network within the community and business sectors, in scientific, environmental areas has shown me the skill, knowledge, passion and the willingness of professionals to share their knowledge, skills and ideas. The flexible approach by the coordinators at RSNZ and my Host organisations and their willingness to direct and guide me in project movements and offer support has made my fellowship progress smoothly and helped to determine my direction."*
>
> Michelle White Hukanui School

In our March survey of 27 Teacher Fellows we asked them to identify gains made from their Fellowship at that stage. In the 24 replies there were 44 references to improved understanding and insight into their topics, 12 to improved professional techniques, 14 to the time to reflect and gain new perspectives, and 7 to new contacts and knowledge of career pathways.

This year we have planned a series of in-service courses for teachers to be given by ex-Teacher Fellows and experts from their host organizations. These courses will be trialed in Terms 3-4 before a decision is made on providing these on a greater scale.

Of the 59 Teacher Fellows in 2004, 55 returned directly to the classroom. 1 took redeployment as a result of a school closure under a School Review by the Ministry of Education, 1 entered theological training, and 2 became education facilitators with other projects (*Futureintech* and *The Whitebait Connection*). This compares to the usual attrition rate of 10.6 % (Ministry of Education, 2005), clearly showing that the Teacher Fellows scheme helps to retain science, technology and mathematics teachers.

PROMOTION OF THE SCHEME TO ELIGIBLE TEACHERS

This year has seen a 10 % increase in the number of applications for 2006. We are still told that the most effective method of promoting the scheme is by word of mouth. Clearly, information about the scheme is not reaching all the eligible teachers.

Regardless of how teachers learn of the scheme, it is personal encouragement that is the key to applying to the scheme. This can be achieved by other Teacher Fellows, host organisation personnel, or RSNZ staff. We find this to be a major activity for staff in the period leading up to the closing date for applications.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

WHY SUPPORT THE TEACHER FELLOWSHIP SCHEME?

Teachers are engaged in a highly focused, responsive and demanding profession. It is very difficult for them to lift their sights above the parapet of their classroom, teaching programme and their students. We address this by providing opportunities for teachers to develop their knowledge, skills and attitudes and to learn about and use the resources around them, be it the professional community or the natural environment. The traditional one-day in-service courses and extra-mural study can be of limited value to teacher professional development.

In order for a teacher to be able to teach with credibility and conviction about research or technological practice, it helps strongly to have recent experience in these. Most initial degrees do not contain any component of such practice. Thus we believe that there must be the ability for teachers to engage in and experience authentic research or technological practice in order for them to be able to teach these activities effectively.

SHORT TERM FELLOWSHIPS

The value of this programme to teachers and students has been amply demonstrated (Jordan and Gault, 1999; Spratt and Knox, 2000). This year, RSNZ has piloted a variation to the Teacher Fellowship whereby a teacher takes a 4-6 week internship with an accredited organization. While the evaluation of this is not yet complete, it appears that this form of release from the classroom to allow teachers to engage in authentic research has benefits.

We wish to pilot a variation on the Teacher Fellowships, a shorter-term, more directed internship. In such a scheme, the RSNZ would determine specific projects in conjunction with research institutions or technological enterprises and offer these to teachers. This programme would be modeled on such programmes in other countries. A start has been made this year with the Liggins Institute, and the results of this trial would inform development of a NZ programme. Scoping and planning of such a programme would require 0.5 FTE and operational expenses in the first instance, and we would aim to have the programme offered to teachers for the following school year. The amount required in Fund monies would be determined during the scoping exercise, but initial estimates would suggest that a start-up amount would provide 30-40 short-term Teacher Fellowships. This would make a worthy pilot.

MORE SUPPORT FOR TEACHERS AND HOSTS

This year we have developed "Sharing the Learning" – a professional development series using ex-Teacher Fellows who share their learning and its application in the classroom with their colleagues. This initiative appears to be very successful with 95 % of participating teachers rating the courses provided so far as highly useful. Pending the results of the evaluation next year, we plan to continue and broaden Sharing the Learning, especially in ensuring that it is accessible to teachers in smaller centres.

Operational costs for Sharing the Learning could continue to be drawn from the Teacher Fellowship Fund, but those for coordination will require provision for an extra 0.4 FTE.

We also provide professional development for teachers through the RSNZ and privately sponsored CREST Awards and the Ministry of Education funded National Waterways Project. This provides good opportunities for us to promote our MoRST funded activities for teachers and students and to demonstrate the coherence between all our programmes.

INCREASING PROMOTION OF THE SCHEME

While great teachers are often found at high decile schools, we believe that there are many great teachers at low decile schools. The scheme has been finding the required minimum of four teachers from decile four schools or below. However, we are not content with the required minimum and would like to carry out further promotion of the scheme.

We believe that the most effective promotion is by personal contact, whereby RSNZ staff visit schools and talk with groups of teachers. Similarly, the most effective way to provide more support for teachers and hosts is through mentoring and transition support.

The provision of a further FTE in staffing would enable us to address these issues above. Because of the types of activities that RSNZ provides, there are synergies from which advantage can be gained in these areas. For example, when CREST is being discussed with an enterprise, Teacher Fellowship hosting is a logical follow-on, or when teachers are carrying out LEOTC National Waterways Project work with a regional council, a Teacher Fellowship will enable that teacher to deepen and extend their knowledge and skills.

Thus we seek an increase in the Contract Management to support the provision of more support, mentoring and promotion.

TRAVEL SUPPORT FOR TEACHER FELLOWS

Finally, the participation of teachers in programmes such as the US Space Camp and Harry Messells Science School have provided a small number of teachers with increased knowledge, access to resources, and enhanced relevance for their teaching. This has in the past been at personal cost to the participants, thus restricting accessibility. We recommend that a small contestable fund be established to support such interaction and participation in the future.

The RSNZ seeks to increase the number of teachers who benefit from such "out of school" activities which refresh, stimulate and enthuse, and we believe that adoption of a programme of opportunities as outlined will provide such benefits now and in the future.

FOSTERING TALENTED YOUNG NEW ZEALANDERS

Output Class 4 – Supporting Promising Individuals- $81,000 in 2005/6, inclusive of GST

OVERVIEW

The proportion of students enrolled in the sciences, mathematics, engineering and technology is below OECD average and substantially worse then that in benchmark countries like the UK. In view of the global shortage of graduates in these areas, we should aim higher. This is underscored by the results of an RSNZ report to MoRST last year on the participation which shows that an alarmingly low 8.5 % of the 100 level EFTS in 2004 were from maths papers, and subjects such as chemistry, physics and engineering rated a tiny 1.5-2 % of the EFTS at 100 level.

Furthermore, an unpublished survey by RSNZ of senior secondary students in Wellington schools in 2002 sought reasons for non-continuation with science subjects as well as opinion on the subjects themselves as they were taught then. A disturbing number of students cited "boredom" or "lack of relevance" as the reasons for non-continuation in the sciences.

We hope to turn the interest of young New Zealanders into a passion for research and technology. We do this in three main ways:

- identifying and communicating with young New Zealanders who show potential in research and technology;
- supporting them in their research or technological practice;
- and recognizing their achievements through awards, participation in scientific activities, and scholarships to international events, giving students experiences of other cultures.

We encourage young achievers through a variety of programmes, some supported by MoRST, others by ourselves or private sponsors, such as the BP Challenge, and the CREST Awards. We also support additional activities through our constituent organisations such as the science, mathematics, technology and social science teacher associations.

The activities currently supported by MoRST are:

- Realise the Dream (30 % support): the annual national celebration of excellence in school student research and technological practice;
- Talented School Students Travel Awards: support for young achievers to participate in international science and technology activities and develop links with international students; and
- Young Achievers Database: identification of and communication with young achievers.

Activities that are supported by private sponsors or by the Society itself are:

- CREST: a national awards programme which supports the S&T curricula; and
- some of the Society's travel awards;
  e.g London International Youth Science Forum, Beijing Science Creation Competition, Queensland Biofutures conference, SEAMEO Search for young scientists.

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.

Young New Zealanders Lychhun Kouch from Aorere College, Auckland and Sarah Wong from Nayland College, Nelson were selected to attend the London International Science Forum. Before they left for London in July 2005, they had the opportunity to meet the Minister of Research, Science and Technology.

> *"All the lectures and places I have visited so far have been fascinating, especially those that relate to neuro science. All the scientists I have met have been very inspirational. And having met them I have a strong conviction that my ultimate goal, as a future scientist and a global citizen is to serve people to make their lives better. The London International Youth Science Forum is a brilliant eye-opener."*
>
> Lychhun Kouch, Aorere College - selected by RSNZ to attend LYISF from 26th July - 12 August 2005

Figure 3. Lychun Kouch & Sarah Wong meet the Minister of Research, Science and Technology, and Jonathon Platt meets Dr Andrew Cleland, Chief Executive of IPENZ

Further success was achieved by Jonathon Platt who participated at Realise the Dream 2005. He was placed 1st in the engineering section at the Taiwan International Science Fair. Jonathon is now in his first year of an engineering degree at Auckland University.

Supported through the Talented School Students Travel Award, Eric Liu and Cameron Cole received bronze medals at the International Biology Olympiad in Beijing in July 2005. Eric Kang and Heather MacBeth received a silver medal each at the International Maths Olympiad.

PROGRESS AND ACHIEVEMENTS EVALUATION

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 practice (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 and technology and entrepreneurialism; and
- Supporting parents and educators to inspire our future wealth creators.

The programme for 2004 included workshops for the participants on presentation and speaking skills, intellectual property, visits to research and technological organizations, demonstrations, visits to sites such as IRL and GNS and a celebratory dinner. Realise the Dream 2004 brought together 35 students from New Zealand ranging in age from 13 to 18 years, two students from Chinese Taipei and two students from Beijing. The students attended a presentation skills workshop where they also had to give a five minute presentation to an audience about their work.

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. Students and sponsors would receive strong validation for the value of their activities from the presence of the Prime Minister at the Awards dinner.

Participants Evaluation of Realise the Dream
21 evaluation reports were completed and sent back by participants. On a scale from poor to excellent, 19 rated Realise the Dream as 'excellent' and two participants rated it at 'good'. Most participants commented that they really appreciated staying together as a group at Weir House. Rated highest were the visits to IRL and GNS, Karori Sanctuary and the presentation about Stonehenge.

Funding for Realise the Dream came from two large supporters, Genesis Energy and MoRST, with contributions from Dexcel, and Victoria University. Funding for the awards came from Genesis, IRL, RSNZ, Dexcel, Statistics NZ, NIWA, DoC, IPENZ, Kiwanis and ESITO.

> *"I think Realise the Dream does indeed fulfil the Royal Society's aim of promoting excellence in science and technology. The interaction of other young people who are like-minded is an integral part of the Realise the Dream programme. I certainly enjoyed the trips to various research and scientific and industrial organisations."*
>
> Matthew Richardson

MANAGEMENT OF SELECTION OF STUDENTS TO PARTICIPATE IN INTERNATIONAL EVENTS

Last year we sent a record number of students on international experiences; this year we surpassed that number. Sixty-six students and two teachers have been assisted to travel to international science and technology events in the July 2004 – June 2005 period. The selection process is carried out by teachers, scientists and sponsors. The international events attended are listed in Appendix 11.

Sixty-two of these students received assistance from the Talented School Students Travel Award, which the Society administers on behalf of the government. Other organizations such as the British Council, Building Research, Asia New Zealand, New Zealand Trade & Enterprise, Kiwanis, and the Institution of Professional Engineers NZ also assisted in funding students to attend international events.

"Thank you so much to the Talented School Students Travel Award in helping to get our team of 12 to the International Future Problem Solving competition in Kentucky.The team worked really hard, were fantastic ambassadors for our country and their work resulted in being placed second in the Evironmental section in the Middle division. I have observed the students growth over the past 18 months which has restulted from this amazing opportunity. They are confident to work with the adults in our community and have developed great public speaking skills and they have built up significant scientific knowledge and best of all they have become passionate about caring for the environment."

Andrea Panther – Deputy Principal, Ahipara School

Figure 4. Beijing Youth Science Creation Competition March 2005, and Chemistry Olympiad Team

DECILE RATINGS

The decile ratings of schools represented by students selected through the Talented School Students Travel Award still continues to be at the higher end of the scale with 18 students selected from Decile 10 schools. This is to be expected as it is the academic elite who tend to apply for selection, many of whom attend high decile schools. However, students of high ability also attend lower decile schools.

The promotion of international events and the TSSTA Fund are publicised to all schools and so all students are given the opportunity for support. It has been pleasing to see that 26 %of the students supported this year are from schools below decile 5.

Table 4. Decile ratings of schools who had students selected by RSNZ to attend international Events

Decile Rating	1	2	3	4	5	6	7	8	9	10
Decile of schools whose applications were successful	0	2	10	2	2	1	17	5	9	18

The percentage of students selected from regions to attend international events varies enormously.

Table 5. Geographical Distribution

Northland	9
Auckland	21

Bay of Plenty	**1**
Waikato	**1**
New Plymouth	**1**
Manawatu	**4**
Wellington	**4**
Nelson	**15**
Canterbury	**5**
Otago	**2**
Southland	**3**

YOUNG ACHIEVERS DATABASE

Our database currently holds information on 1015 young achievers aged from 6 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 practice and opportunities such as scholarships and competitions.

The database has been redeveloped 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.

> *"I would say without exaggeration that the process began while I was in High School, having been given the opportunity through the efforts of RSNZ to participate and succeed in the 1998 ECNZ Science and Technology Fair. I have been keeping in touch with RSNZ through the database initiative for a number of years. In 2002 I graduated from Pharmacy School at the University of Otago and was awarded the Boots Healthcare UK Grant to undertake professional training in Nottingham and attend my first International Pharmaceutical Students' Federation Congress in Budapest, Hungary. Over 2003-2004 I set up the NZ national association of pharmacy students and young pharmacists, became its founding President and represented NZ internationally at the International Pharmaceutical Students' Federation (IPSF). Last year through your networks, Mark Holman from the Ministry of Research, Science and Technology approached me to make a presentation at the APEC Science Ministers Meeting last March in conjunction with two other young people whose lives have also been touched by the RSNZ. Last year in July, I was elected to the position of President of IPSF and now live in The Hague, the Netherlands working full time for the organisation.*
>
> *I applaud the efforts of the RSNZ to connect youth with science, recognise and encourage innovation and give them a chance to be on an international stage. The benefits can indeed be far into the future, but it is worth it to foster sustainable development and encourage an aspiring individual to fulfil their dreams knowing that anything is indeed possible. Many sincere thanks for giving me one of the first steps leading to a succession of leaps"*
>
> Tana Wuliji – Young Achiever's Database

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 appropriate young New Zealanders to be involved in such occasions to promote science and technology and demonstrate the capability of New Zealand's future scientists and technologists. Such activity has also been very beneficial for the young people.

CREST — CREATIVITY IN SCIENCE AND TECHNOLOGY

CREST is a national awards programme which provides a framework to support students in their learning in science and technology. Undertaking a CREST Award gives pupils authentic experience in scientific investigation or technological practice of their own choice, working with an outside consultant/expert to investigate issues of real

significance in their lives. It thus supports all students as well as providing extension for the talented and those with a particular interest.

There are 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 the school community are required and have clearly defined roles.

The Royal Society has been supporting CREST for several years now, and we were pleased to gain support this year from the Todd Foundation for a three year period. This support will enable us to make CREST available on-line and so greatly broaden its accessibility to students as well as improve response time and administration. We are also providing workshops on CREST to teachers; this has also bee assisted by sponsorship from the East Coast Trust Bank Trust. (Further support has been received in the 2005-06 year from the Auckland Trust Bank Trust and the Ministry of Education - this will be further commented on in the 05-06 PAR). These workshops are proving very successful in encouraging and supporting teachers to offer CREST to their students.

Our goal for CREST is to make it fully accessible to all students and teachers and to have students in at least 80 % of the 592 secondary, composite and intermediate schools engaged in CREST. These students would be supported by a network of regional part-time facilitators under the guidance of a CREST National Director. Now that our Supporting Talented Young New Zealanders is under separate contract to the Ministry of Research Science and Technology, we will be including the CREST Awards in our negotiations for this contract in the future.

OLYMPIADS

The International Science Olympiads are a collection of subject based competitions for high school students. The first to be held was the International Mathematics Olympiad in Romania in 1959. It was soon followed by Olympiads for Physics, Chemistry, Informatics, Biology, Geography, and Astronomy. A Junior Science Olympiad was launched last year in Indonesia and indications are that Indonesia is also hosting a 2005 event. Planning is taking place for an Earth Science Olympiad to which New Zealand will be invited in 2006/7.

New Zealand first participated in the Mathematics Olympiad followed by Physics and Chemistry. Government support for the Mathematics, Chemistry, and Physics Olympiads was provided from 1995 to 1997 through the Minister of Research Science and Technology's Science and Technology Promotion Advisory Committee. Support from this source ceased in 1998 when the selection criteria for the Fund changed. New Zealand has taken part in the Physics, Informatics, Geography, Mathematics and Chemistry Olympiads with continued participation only in Maths and Chemistry. Funds are raised by the participants and organising committees.

The Royal Society has always expressed the view that all Olympiads should join to gain the benefits of collective administration and fund-raising. However we do not have the resources to initiate such a move. The Society itself initiated NZ participation in the Geography Olympiad in 1999 sponsored by the National Geographic, but this too was unable to be sustained due to lack of resources.

The purposes of Olympiads are to:

- stimulate active interest in research by the creative solution of scientific and mathematical problems;
- promote exchange of ideas and materials about science and mathematics education;
- promote regular international contacts between students of the sciences and mathematics; and
- establish friendly relations among young people from different countries and thus to stimulate cooperation and understanding between nations.

We intend to include the Olympiads in our discussions regarding the Talented Young New Zealanders contract for future years. Our proposal will involve the provision of appropriate material for use by teachers in their classroom and/or extension programmes to stimulate, encourage, and identify those students gifted and talented in the particular areas of the Olympiads. These materials will be prepared by researchers and practitioners in the field together with teachers and supplied to teachers for their use. This material will be used by potentially about 20,000

students in school or at home, and will be used to enable the initial identification of the students invited to Olympiad training. Our proposal will go a long way to overcome many of the cited barriers (Ministry of Education 2002) to identification of gifted students by teachers such as low teacher expectations, bias, inadequate teacher preparation in testing, assessment, multicultural and gifted education and/or inhibition of student participation by conditions of poverty or geographic isolation.

Our social, economic and environmental future is based on investing in our young people. 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. CREST Awards and Olympiads, together with current RSNZ programmes, leverage 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.

> *"Of course, such an incredible experience wouldn't have been possible without funding, and I owe an enormous thank you to the Royal Society of New Zealand and its Talented School Students Travel Award Committee. It is all very well to select and train a New Zealand team, but without funding nothing can go ahead. I'm indescribably glad that it did: the IBO was something I'll be telling my children (and grandchildren!) about, and something I'm really proud to have been a part of."*
>
> Kate Duggan International Biology Olympiad

Figure 5. 2005 International Biology Olympiad team

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

Participation by school students in sciences, mathematics, social sciences and technology subjects is on a par with countries such as Singapore, Korea, Japan, and Finland; those that we aspire to. In contrast, NZ graduates far fewer New Zealanders in these areas, particularly in engineering, from universities. What can we do to reduce the disparity and stem the loss of these talented young people?

The two main areas that we believe would make the greatest impact on encouraging, enthusing and supporting young New Zealanders into sciences, mathematics, engineering and technology are:

- The provision of opportunities for such talented young New Zealanders to meet and interact with others of like mind as well as with inspiring practitioners, and
- Enabling such students to gain experience in research and technological practice, be it through following through with their own investigator-initiated work or by working within established programmes such as the work experience awards from Realise the Dream or our new, privately sponsored BAYERboost scholarships which will give senior secondary and undergraduate students paid holiday work experience in the environmental/conservation area.

OPPORTUNITIES FOR YOUNG ACHIVERS

Young New Zealanders take a variety of routes to life-long interest or careers in research and technology. No single model of support will work. The Royal Society, as the national body for science education, would like to be able to offer a range of coordinated programmes to meet the need for this support.

INFORMATION AND OPPORTUNITIES FOR YOUNG ACHIEVERS

Such coordination will improve access to such opportunities by more students and teachers than at present.This would require an expansion of our current Young Achievers programme to enable us to scope and collect information and opportunities for young New Zealanders in the school-tertiary age group, to provide interactive web communication with them and to encourage and support them in their science and technology. Through this we would aim to ensure equity of opportunity for all. Such a move would initially require a further 1 FTE and an operational budget.

CREST

The CREST Awards have been supported by the RSNZ and private sponsors, notably the Todd Foundation. Development of this programme which encourages and supports students into carrying out their own research or technological practice has been severely hampered through lack of support. At last we have been successful in gaining such support but, sponsorship always uncertain and requires a great deal of effort to obtain. Provision of 1 FTE as base staffing for the CREST Awards would assist the stability of operation and raising of private sponsorship for development of support to students and teachers.

OLYMPIADS

There are 8 Olympiads in sciences and technology in which New Zealand could participate but there has not been sufficient financial support to allow this. We believe that the time has come for provision of centralized administration and support for this programme which undoubtedly encourages, supports and extends those who take part, from the hundreds of students involved in school in the identification process through to the few who compete at the international level. In each case and at each level, these are students who would not normally be provided with such opportunities for extension and interaction.

Administration and support for Olympiads in 2006 would initially require 0.6 FTE with an operational budget. This would rise to 1 FTE by 2008 as all Olympiads come on stream. Provision of base funding for administration will enable RSNZ to garner much more in support from private and non-governmental organisations.

NATIONAL CONNECTION PROGRAMME

One of the things that our Young Achievers want is the opportunity to meet with others of like mind and interests. While a certain level of communication can be carried out through the internet, this could be strengthened through working with organizations such as tertiary institutions, research institutions, museums and schools to develop a national programme of regular, perhaps quarterly, local meetings, visits and workshops. The successful Australian CSIRO Double Helix Club could provide a model for such a programme. Such a programme could be based in up to 46 urban and rural centres such as Te Kuiti, Kaitaia, Gore as well as the major centres in order to reduce travel costs and time so that as many young people as possible could participate. In full operation such a programme might require 2 FTE and many part-time facilitators to act as local coordinators – probably a further 2 FTE – and perhaps operational costs. Many of the costs involved might be able to be met locally, and we would require local programmes to complement existing programmes such as RSNZ branch activities, the Futureintech programme, and the Association for Gifted and Talented programmes. We plan to scope this concept through 2005-06 and provide a proposal for the following year. We are not making a recommendation this year.

TALENTED SCHOOL STUDENT TRAVEL AWARD

There is also a range of other activities where we identify and reward talented young New Zealanders. Competitions such as the genETHICS competition or selections for the international events such as the US Space Camp or the Beijing Future Science Creation competition allow us to promote and reward while, at the same time, exposing young New Zealanders to others of like mind and to other cultures. We also believe that it is essential for New Zealanders to gain an appreciation and understanding of other cultures, and this is why we feel so strongly about providing such opportunities for our talented young. For these reasons, we were delighted at the establishment of the Talented School Students Travel Award two years ago and by the commitment from Government to its growth to enable more young New Zealanders to benefit from scientific and cultural interchange with young people from overseas.

> *"Thank you so much to the Talented School Students Travel Award in helping to get our team of 12 to the International Future Problem Solving competition in Kentucky. The team worked really hard, were fantastic ambassadors for our country and their work resulted in being placed second in the Environmental section in the Middle division. I have observed the students growth over the past 18 months which has resulted from this amazing opportunity. They are confident to work with the adults in our community and have developed great public speaking skills and they have built up significant scientific knowledge and best of all they have become passionate about caring for the environment."*
>
> Andrea Panther Deputy Principal, Ahipara School

At present we receive no management fee for administering this fund. While we were able to carry this when the fund was smaller, it has now reached a sufficient level of activity where we require 0.2 FTE for this purpose. We were also pleased to be able to carry out selections this year for three PhD students to attend the Lindau Nobel meeting, and hope we can continue to do the same in the future for this as well as increasing the number of such opportunities for school and tertiary students. This can be managed within the Young Achievers programme, but will require provision of support for operational costs such as student registration, travel and accommodation.

WORK EXPERIENCE SCHOLARSHIPS

The other area of support for young New Zealanders is the provision of work experience and financial support. We have recently launched such a programme of scholarships for senior secondary and undergraduate students with the support of Bayer New Zealand Ltd. The sponsorship allows for students to carry out environmental/conservation holiday work with an accredited organization and be paid. A more inclusive programme of scholarships would allow the provision of a wider range of work experience to more students and enable young people to engage in research and technological practice at a time when they could change direction in their career pathway.

The initial scoping and preparation of such a programme would require 0.4 FTE and a small amount of cost to allow discussion with organizations which could host these scholarships, and then full operation would probably involve 1 FTE. Funding for 100 scholarships, but this level would not be achieved for a couple of years. We would suggest introducing the programme with up to 40 scholarships in the first year. This would require 0.5 FTE and scholarship funds.

A CONTINUOUS PATH OF SUPPORT TOWARDS A RESEARCH CAREER

Adoption of the above proposals would thus provide a wide reaching network by which to attract and engage young New Zealanders and support and encourage them into science and technology. The provision of opportunities for them to learn from others, to share amongst themselves and to gain experiences and financial support special to them will attract and influence students. It will also enable us to identify, track and support these students into scientifically and technologically based careers.

To provide these varied kinds of support, we request financial support for operations and 3.3 FTEs.

INTERNATIONAL

Output Class 5 –Contestable Programmes of the International Science and Technology Linkages Fund- $560,000 in 2005/6, inclusive of GST

International collaboration is becoming increasingly important to NZ researchers because of the need to engage with the best scientists worldwide so that they remain at the forefront of world class science. 99.8 % of global research, science, and technology is carried out overseas. New Zealand accrues tangible benefits from connecting to overseas research. The Society contributes to this connection through the management of the International Science and Technology (ISAT) Linkages Fund.

INTERNATIONAL SCIENCE AND TECHNOLOGY (ISAT) LINKAGES FUND

OVERVIEW

The primary purpose of the ISAT Linkages Fund is to support the development and enhancement of research relationships with other countries with an emphasis on supporting new activities and relationships. The Fund facilitates bilateral research by funding New Zealand resident researchers to travel overseas or for overseas researchers to travel to New Zealand to work on joint research projects. Funding generally supports travel and related costs.

The Fund is contestable and funding is keenly sought from the NZ research community. The Royal Society began to administer the Fund in 1998. Since then there have been 776 recipients with a grant value of almost $3.0m. 47 different countries have been involved.

HIGHLIGHTS

Considerable feedback in regard to the Fund has been received:

> *"A promising young researcher has now developed strong working relationships with key researchers at the Australian national nuclear research and development organisation. As a direct result of this collaboration she has successfully developed a new FRST-funded research programme."*

> *"The grant enabled me to initiate a long-term collaboration with my overseas collaborator. This has allowed me to expand my original study and has also enabled me to attract additional funding. The overseas collaborator, other researchers (from South Africa, Venezuela, and the USA), and myself are presently applying for large grants from the USA National Science Foundation."*

The following are examples of ISAT Linkages Funded projects funded in 2004-05:

Enhanced Geothermal Systems
Dr Bruce Christensen, Institute of Geological & Nuclear Sciences received a 2 year grant to collaborate with Dr Peter Rose and Dr Michael Adams of the University of Utah, USA to carry out a joint project on "Enhanced Geothermal Systems". The primary objective of this collaboration has been to join NZ, France, Switzerland, and USA's expertise to advance the Enhanced Geothermal System project at the Coso Geothermal System based in California. Enhanced geothermal systems (EGS) are engineered reservoirs created to produce energy from geothermal resources deficient in economical amounts of water and/or permeability. Enhanced geothermal technology will increase the productivity and lifetime of those reservoirs. The U.S. Department of Energy estimates that the application of enhanced geothermal technology can more than double the amount of viable geothermal resources in the West. Year 1 brought both parties together on two occasions and the grant was the vehicle by which both institutions were able to establish formal collaborative ties. As a consequence, the collaboration is providing NZ-based funding agencies (ie Mighty River Power, Contact Energy, FRST) evidence that NZ is at the forefront of

research into deep geothermal resources. These parties are now considering forming a joint FRST Research Consortia around deep geothermal research.

Tuberculosis and Ethnicity in NZ and Canada
Dr Julie Park, University of Auckland received a one-year grant to help bring two established multidisciplinary teams together to develop a comparative study of First Nations, Māori, and Pacific Island experiences with tuberculosis. The purpose of this study was to highlight common and unique aspects of the complex history and geography of the disease. It is the intention of the teams to seek significant funding in an endeavour to further study tuberculosis and its implications.

PROGRESS AND ACHIEVEMENTS EVALUATION

Early in 2005 an evaluation of the ISAT linkages fund was carried out by surveying recipients of ISAT Linkage Fund support in 2001, 2002 and 2003. The main areas the evaluation focussed on were:

- the scheme has been successful in enabling emerging researchers to form long-lasting collaborations. More than 9 in 10 can be expected to exist a year or more after funding has ceased;
- funded projects are extremely productive;
- over half of contracts resulted in peer-reviewed publications;
- a significant proportion of contracts led to the creation of new products and new intellectual property;
- half of contracts enabled the establishment of new research skills and/or methods in New Zealand; and
- two thirds of contracts resulted in the formation of new collaborations in addition to the funded linkage;
- ISAT Linkages-funding is a lever to additional mainstream funding instruments. More than half of contracts resulted in further applications for funding, and in the majority of cases these applications were successful.
- The evaluation was unable to identify barriers to collaboration faced by the Fund's recipients as the vast majority of projects examined were successful. However, many recipients noted increasing tension between the Fund's success rate, the low level of award, and, what is perceived as being a difficult application process.

The complete report can be found at http://www.rsnz.org/funding/evaluation/.

The ISAT investment results in long term on-going collaboration
The majority (92 %) of collaborations still exist one or more years after funding has ceased, demonstrating that ISAT supports linkages that form substantial, long-lived, collaborations. Surprisingly, the proportion of linkage reported as ended appeared unrelated to time elapsed since the contract had been awarded, suggesting that collaboration are at their most fragile in the first year following ISAT-support, but if they are able to survive this period they will be essentially stable.

ISAT-Linkages funding leads to securing funding from mainstream sources
More than half of contracts (54 %) led to applications for further funding. The most common funding sources approached were FRST and international funding agencies (44 % and 40 % of contracts seeking funding), which were followed by the Marsden Fund (30 %), non-funding agency sources (25 % national and 17 % international) and the HRC (4 %). Success rates for all agencies were equal to, or in excess of, 50 % with one obvious exception: in bids to the Marsden Fund, ISAT recipients tended to be no more successful than the typical Marsden applicant. At a conservative estimate, the government's investment of $754,625 on the contracts surveyed helped to leverage between $2.8M–$4M in additional funding of which of which a minimum of $1.1M came from overseas.

The collaborations supported by the Fund are extremely productive
ISAT-supported collaborations are scientifically productive; over half of contracts (56 %) resulted in peer-reviewed publications, and approximately 1 in 12 (8 %) of respondents stated their contract lead to the creation of new products, while 1 in 6 (16 %) resulted in the development of new intellectual property. The ISAT programme has also fostered significant growth in the research capacity of the recipients. Roughly half of all contracts allowed the establishment of new research skills (53 %) and/or new methods (47 %) in New Zealand. Of particular interest, two thirds of contracts resulted in the formation of new collaborations in addition to the supported linkage.

ISAT-Linkages funding has positive effect upon its recipients careers
Surprisingly for such a small award, approximately three-quarters of recipients (76 %) stated that as a result of the collaboration the career development of those involved had been influenced. In all cases where more detail was offered, the ISAT award was described as having positive effects, such as:

- enhancing the researcher's profile and/or prestige;
- contributing to the development of a productive research programme, and new collaborative networks;
- generating high quality publications and/or leading to further funding opportunities;
- assisting with the establishment of new student programmes; and
- influencing promotion.

BARRIERS FACING RECIPIENTS

The majority of respondents (137 or 83 %) provided one or more comments on the Fund's administration. The most commonly expressed statements supported the current application (44) and reporting (65) processes, and noted the recipient's positive opinion of the Fund (44). However, a large number of comments were to the effect that the application process was too difficult and/or laborious (41), or noted concerns regarding the value of the award (36), with half of these respondents explicitly linking the two, i.e. the effort required for application was too great for the level funded.

The recent evaluation of the Fund indicated that the application process required simplification and we can report that the Society has simplified the form.

SCOPE, SCALE, APPLICATIONS AND SUCCESS RATES

The scope, scale, applications and success rates are described in Appendix 10.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

The ISAT Linkages Fund programmes have been a resounding success. The programmes have fostered significant growth in the research capacity of recipients of grants through international collaboration. Evidence shows that approximately half of the recipients have attained new research skills or methods while three quarters of the recipients have had their career development enhanced, particularly with "young" researchers. Evidence also shows that more than half of the outcomes of the international collaborations funded through the programme have resulted in papers being published in peer-reviewed publications. It has also led to successful applications to other Funds - it is known that the programme has helped leverage $3.0 to $4.0 million in additional funding.

International links are unanimously viewed as being important in gaining access to and sharing information, resources, data banks, state-of-the-art equipment, methodologies and techniques.

At $560k the programme is always heavily oversubscribed and an immediate increase needs to be addressed if the impetus and success of the programme is to be maintained. The programme should be increased over the next 4 years to reach $1 million by the year 2010.

These proposed funding increases will result in increased workload for the fund management. The initial setup costs of this would require an additional 0.6 FTE.

THE RSNZ SCIENCE AND TECHNOLOGY COMMUNICATIONS UNIT

Output Class 6 – Promotion of Science and Technology

The Communications Unit brings together a range of groups, individuals and activities and runs programmes with national impact.

OVERVIEW

As the developments and effects of science and technology on society accelerate, so does our responsibility to keep people informed, and promote public discussion of the implications. The past informs the future, and so the history of science, the responses of previous generations to new developments, and knowledge of fundamental scientific concepts such as evolution and electromagnetism – are all important to our understanding and judgement of science and technology today.

The increasing demands on people's time, and the competition for their attention from myriad sources, makes the communication of complex ideas a real challenge. The lack of scientifically literate journalists makes the task even more difficult.

Recent research carried out by MoRST shows that there is a high degree of trust in our scientists, and that people want to hear about science from scientists themselves – if indeed they want to hear about it at all. This finding is strongly endorsed by the Society, and implemented via its own communications programme:

- Radio interviews with scientists, where they can tell their own story (e.g. the regular slot that Professor Paul Callaghan has with Kim Hill).
- Lectures and talks throughout the country, with radio broadcast series (and repeats, totalling 26 broadcast hours) in the last two years vastly increasing our audience.
- Briefings for MPs by our top scientists.
- Bringing high profile international scientists to tour and speak in New Zealand.
- Exciting popular events where scientists interact directly with young and old.
- One-on-one creative relationships between scientists and artists (e.g. Are Angels OK? Smash Palace project).
- Video competitions which have brought many students, their schools and communities, into direct contact with New Zealand and international scientists (e.g. The Newtonian Chicks – ordinary girls from Kaitaia – presented their work to physicists at Oxford. The Nelson College boys met many top Cambridge scientists, including Stephen Hawking).
- For three years we have been running training courses for younger scientists in media and presentation skills so that more scientists have the ability and confidence to get out there and talk to people, especially media. We keep a database of the more than 100 science communicators to respond to requests from community groups for speakers.

EMC² THE STORY OF THE UNIVERSE

UNESCO declared 2005 World Year of Physics in honour of Einstein's brilliant, and still relevant, achievements a century ago. We decided to make it our major theme for this year and formed collaborations with the universities and the NZ Institute of Physics. Many of the country's physicists are already well known to us. Physics is a tough topic to popularise. It has a reputation for being formidably difficult. All the more reason for taking it on, we reasoned. To increase the popular appeal of this education promotion, we entitled it $E=mc^2$ The Story of the Universe. The funding for Year of Physics activities is described in Appendix 12.

EMC² VIDEO COMPETITION FOR SECONDARY SCHOOLS

Our excellent sponsor for the Transit of Venus – Freemasons New Zealand – liked the idea of Einstein and $E=mc^2$ as a theme. Accordingly, they provided major sponsorship for the school video competition. The top 12 entries showcase a wide range of young New Zealanders. Kaitaia's Newtonian Chicks put distinctive New Zealand humour and the natural performing talents of their local community into some brilliant demonstrations of Newton's Laws as they apply in Northland. TV One News and Close Up did stories on Upper Hutt College and the Newtonian Chicks respectively.

Fifty nine schools entered, and many schools had more than one team competing for the honour of representing the school. The two winning teams went on fabulous all expenses paid trips to the UK and Europe in June. The other finalists went to Stonehenge in the Wairarapa for a three-day camp in September.

ROYAL SOCIETY EMC² LECTURE SERIES ON NATIONAL RADIO

Radio New Zealand is often our first port of call when we have something to say to the wider community as its audience is large, influential, and intelligent.

The seven lectures organised by the Royal Society were delivered to capacity, or near capacity, audiences in Whangarei, Auckland, New Plymouth, Palmerston North, Wellington, Nelson and Timaru. Topics ranged from cosmology to science and religion, and the development of quantum mechanics. As for the Transit of Venus series last year, there has been a brisk trade in recordings of the lectures through Radio NZ's Replay service. Awa Press intends to publish both series.

OPENING OF STONEHENGE AOTEAROA

Stonehenge Aotearoa was part-funded by the government's Science and Technology Promotion Fund, and constructed by many thousands of hours of loving voluntary labour.

As a symbol of mankind's first attempts to measure, understand and predict events, we decided that Stonehenge Aotearoa was the perfect place to launch our programme for Year of Physics. There was phenomenal national and international media coverage of the opening of this wonderful new science centre, which has seen a steady stream of visitors ever since.

ARE ANGELS OK? SMASH PALACE FUND PROJECT

Together with the International Institute of Modern Letters, headed by Professor Bill Manhire, the Royal Society has enlisted New Zealand's top writers to communicate the wonder and mystery of the physics of our Universe – particles that dance in and out of existence, the 11 dimensions of the early universe, the wave-particle nature of light, and the uncertainty principle.

"Are Angels OK?" asked Bill, wondering if we would be prepared for writers' creative interpretation of these concepts. Thus began a spirited dialogue between ten of New Zealand's creative writers - Elizabeth Knox, Witi Ihimaera, Margaret Mahy, Vincent O'Sullivan, Glenn Colquhoun, Lloyd Jones, Catherine Chidgey, Dylan Horrocks, Chris Price, and Jo Randerson - and our physicists, led by Professor Paul Callaghan. Thanks to the government's sci-art Smash Palace Fund, this unique anthology of writing will be published in 2006 (if the project goes through to Phase 2).

WWW.E-EQUALS-MC2.COM SUPPORTED BY A GRANT FROM THE GOVERNMENT'S SCIENCE AND TECHNOLOGY PROMOTION FUND

E-net Ltd (the e-learning company that developed an excellent educational website for the Transit of Venus celebration) won a grant from the government's Science and Technology Promotion Fund to create a website tracing the genealogy of physics from ancient times, through to the current work of New Zealand physicists. The website's also hosted the $E=mc^2$ video competition described above. The University of Auckland, which has put a considerable amount of effort into the site, intends to maintain and develop it after this year.

INTERNATIONAL SPEAKERS

Several leading physicists from the UK and the US have been invited to tour New Zealand during the course of the year, each hosted by one of the universities or other institutions, and shared with the rest of the country. The Royal Society's role is to coordinate each tour, and manage media coverage in some cases. So far we have had:

- Professor Frank Close (particle physicist from Oxford University);
- Popular science author Dr Simon Singh (author of Fermat's Last Theorem, The Code Book and Big Bang);
- Professor Mark Warner (ex-pat from the Cavendish Laboratory, Cambridge University);
- Professor Gerry Gilmore (deputy director of the Institute of Astronomy, Cambridge University, another highly successful New Zealander);
- Dr Randall Caton (NASA education outreach); and
- Mick Nott (UK science education consultant).
- Professor Malcolm Longair (Head of the Cavendish Laboratory, Cambridge University)
- 2001 Nobel Laureate (Physics), Professor Carl Wieman.

This adds up to a lot of lectures and a lot of work. The popularity of many of these speakers meant that we had to ticket the lectures in order to control numbers.

EINSTEIN 2005 LECTURE SERIES

This year-long lecture series in Wellington was organised by the Royal Society in partnership with Victoria University and the MacDiarmid Institute. As well as most of the international visitors listed above, the series includes lectures by eminent local physicists. Every lecture has been packed out, and in the case of Simon Singh, we had to set up a screen outside the theatre for the 100 or so extra people who turned up. This shows that there is a real public appetite for science, particularly cosmology and particle physics.

We have facilitated many more lectures in other centres, hosted by Otago and Canterbury Museums and the universities. The UNESCO NZ Science Lecture, delivered by Gerry Gilmore, was organised by the Royal Society and held in Palmerston North, where it attracted 360 people.

THE ROLE OF THE ROYAL SOCIETY

Except for visits by overseas speakers, none of these activities would have occurred without the Royal Society initiating, coordinating and managing them. We cannot over-emphasise our unique role with this type of programme, which is able to transcend competition between universities. Everyone has benefited from these collaborations, and we have ended up with a very significant and worthwhile programme, which will have long term effects.

SPEAKER'S SCIENCE FORUM

Using its own resources, the Society organised its third series of seven briefings-cum-dinner for MPs. The most popular was Ian Pool's overview of the Big Demographic Picture. Ian Pool's graphs showing the implications of discontinuous female fertility showed MPs just how difficult public health and education planning are going to be. MPs asked us for another Speaker's Science Forum on the subject.

MASTERCLASS! SCIENCE ON AVIAN FLU

In August, two world experts on influenza visited New Zealand to give a series of seminars. They were Dr Alan Hay, Director, WHO Influenza Centre, National Institute of Medical Research, London, and Dr Frederick Hayden, Professor of Clinical Virology, University of Virginia, US.

What if there were to be a major outbreak of influenza in New Zealand? How likely is another pandemic? The visit by Drs Hay and Hayden helped our scientists put these issues on the public agenda. Although New Zealand

scientists and health officials are well up to date with worldwide developments, Alan and Frederick were able to inform a much wider group than those immediately involved in the issue.

ROBERT LORD WINSTON: 2004 ROYAL SOCIETY DISTINGUISHED SPEAKER

Who would have dreamed that such a thing was possible: 1400 people at a science lecture on a weekday afternoon. Palmerston North's Regent Theatre was filled to capacity long before the lecture started, and the traffic in the streets around the theatre was so gridlocked that the speaker found it hard to get to the venue.

Lord Winston committed to a punishing schedule of lectures. He opened Canterbury University's College of Science, the SciCon Teachers' Conference in Christchurch (in support of a profession he values highly), gave a special presentation at Parliament on human assisted reproduction, and gave three public lectures in Christchurch, Dunedin (as part of the International Science Festival) and Palmerston North. He also talked to policy people in Wellington about reproduction technologies and their implications.

The Royal Society is grateful to David and Genevieve Becroft in Auckland for financing the visit of this science superstar.

SCIENCE HONOURS DINNER

This was the second such occasion organised by the Royal Society. It was held in Christchurch on Wednesday 17 November to coincide with the Annual General Meeting of the Fellows of the Royal Society and the Conference on energy. Professor Ian Shaw, Head of Canterbury University's College of Science, was MC for the evening, which was attended by 190 guests, the maximum number possible at the venue. The Rutherford Medal for Science and Technology was presented to Professor David Penny of Massey University by the Minister of Research, Science and Technology. Professor Peter Barrett's statements at the dinner about climate change certainly got media attention.

ROYAL SOCIETY COMMUNICATIONS COURSES

This subsidised course for young scientists on presentation and media skills continues to be popular. Unfortunately tragedy struck one of the course leaders early this year, and we had to postpone the course till late August 2005. This course was fully subscribed.

HIGHLIGHTS

Here are some impressions and highlights from Year of Physics so far…

On an outrageously windy day in February, beloved New Zealand scientist, Alan MacDiarmid, manages to land by helicopter at Stonehenge Aotearoa in the Wairarapa. Television crews vie for interviews with Alan and other science celebrities. The Stonehenge website receives over 36,000 hits a day!

The surprise announcement at school assembly that the Fairfield College team had won one of the two big prizes in the $E=mc^2$ video competition, results in an eruption of joy and tears.

The judges give the Newtonian Chicks from Northland a spontaneous round of applause for their video. Even the lofty physicists at Oxford University are impressed.

At 6pm on a cold winter's night in Wellington, a long queue waits anxiously outside Rutherford Lecture Theatre 1 with hopes of getting into Simon Singh's lecture without a ticket. The tension is palpable. Those that were lucky to get in heard Led Zeppelin backwards, and learnt about the characteristic emission of sodium from an electrified gherkin.

Chris Laidlaw receives more positive emails about his interview with ex-pat cosmologist Gerry Gilmore than about any other interview.

The $E=mc^2$ lecture series on Radio New Zealand is so popular that many people have paid $100 for the boxed set. A pensioner in Feilding whose car broke down on the night of the Palmerston North lecture, was relieved to be assured that she could hear it on the website.

Kim Hill and Paul Callaghan talk about life - how the perpetual restless motion of atoms (the Brownian Motion finally explained by Einstein) shuffles enormously complicated 2000-atom proteins into just the right shape to carry out their function – whose pinnacle achievement is to enable us to understand them.

PROGRESS AND ACHIEVEMENTS EVALUATION

MEDIA COVERAGE

This year we have received much more radio and television than print coverage. The change of science round on the Herald has diminished the quality and quantity of coverage of science in this paper. The other metropolitan dailies have been equally disappointing.

Conversely, Television One is now quite receptive to ideas for news stories. Television One News did a story on Upper Hutt College's attempt to explain special theory of relativity in the video competition, and Close Up went to Kaitaia to do a ten-minute item on Kaitaia College. TVOne and 3 both did extensive news stories on Stonehenge. The audience for these programmes is extensive and made up for the relative lack of interest by print media.

Radio New Zealand has been very receptive to all our ideas for interviews and programmes. Kim Hill has constantly referred to Einstein's year, and her regular interviews with physicist Paul Callaghan have been a major contribution to public science education.

Kim Hill interviewed Alan MacDiarmid and Richard Hall (Stonehenge) and Chris Laidlaw broke the Sunday morning programme's format to air a 50 minute interview with Gerry Gilmore. The content was so interesting that he didn't want to edit it.

And, of course, Radio NZ has also broadcast (twice) the $E=mc^2$ lecture series, which received glowing praise from Camille Guy in the NZ Listener.

As already mentioned the coverage of the opening of Stonehenge Aotearoa was exhaustive and exhausting for the protagonists, who had to do one interview after another. A number of overseas media carried the story. There was also saturation coverage of Lord Winston's tour last year, proving yet again the value of bringing in high profile scientists.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

The Society is well placed to promote awareness and knowledge of science and technology through the media and directly to public and professional audiences:

- we are independent;
- we don't push any particular line;
- we represent many scientists with a range of views;
- we have a good reputation;
- we use the best scientists in New Zealand regardless of their institution or whether they are Fellows or members of the Royal Society;
- we have ten branch organisations to spread the word;
- the media trust us, and recognise that our imperative is the communication of science, not promotion of the Royal Society as an organisation;
- we have excellent national networks and knowledge of who is doing what there are many synergies with our work on the Marsden Fund and other research and education initiatives;
- we have a proven reputation for initiating and organising high impact national events; and
- we play a vital coordination role in science promotion.

The limited public attention span, the difficulty of interesting some media in science stories, and our heavy reliance on mainstream media to reach significant numbers of New Zealanders, mean we have to be extremely creative, put up the best possible interview talent, invent new forums, exciting events and competitions. The Royal Society has been particularly effective in all these areas.

The Society wants to expand its activities from events and lectures to more issues-focussed activity. We wish to be the first place that New Zealanders, and in particular journalists, come to for high quality independent information on controversial issues such as genetic modification, cell phone radiation, climate change, sustainability, energy options, stem cell research, immunisations, nanotechnology etc. We can use our strong networks throughout New Zealand, including the Branches of the Royal Society, to organise discussions with members of the public and stakeholder groups.

The Ministry of RS&T is rightly focussed on science in society issues, and the need for dialogue with the public. The independence and high standing of the Royal Society make it the ideal body to be the interface between the public, government, scientists, science institutions and the media. We possess the expertise and connections to conduct dialogues on science and technology. Using our own resources we are inaugurating this year a series of Talking Technology dialogues on topics of public interest.

This is not the kind of activity for which we would seek sponsorship. Sensitive discussion about controversial issues such as cell phone radiation should not be directly sponsored by a phone company!

The Society currently uses two first class freelance writers who have science degrees and in one case a doctorate in science communication. However, we believe that significant advances into stakeholder dialogue and communication of the science story could be made by an increase of three FTE, for a total of five in the unit. Their immediate task would be to develop a strategic plan for the area, for discussion with both MoRST and the Council of the Royal Society, so that the most effective set of goals and specific programmes could be put in place. The Society therefore proposes that funds be made available for three positions beginning in 2006.

CONTESTABLE FUND FOR SCIENCE AND TECHNOLOGY PROMOTION

Output Class 6 – Promotion of Science and Technology - $420,000 in 2005/6, inclusive of GST

The Promotions Fund helps start a range of creative science promotion activities.

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.

The nine projects funded in 2004/5 were:

- A visitor centre video about electricity in the first town in New Zealand to use street lighting
- A roadshow featuring live tuatara, explaining how scientific knowledge is helping in their preservation and giving both a scientific and Māori perspective on the place of tuatara within New Zealand culture
- A sophisticated website for the Year of Physics featuring web-streamed videos, interviews with scientists, video conferences and an interactive experience of physics
- Project linking underwater microphones to a portable interactive display allowing the general public to immerse themselves in the undersea sound environment while keeping their feet dry
- A series of community dances and mathematical performances using the patterns of dancing to explain the ideas behind mathematics
- Trading card project designed to connect science and 'tween' culture
- Touring exhibition about waves and physics of motion
- Interactive models in science exhibition
- Partnership between businesses and schools using the theme of water to motivate young people in the way they think about science

For a fuller description of the projects funded in 2004/5 and their progress to date, see Appendix 13.

HIGHLIGHTS

Two projects in particular will be highlighted. The first is SciCards, is a trading card game designed to connect science and technology with the 'tween' lifestyle such as skateboarding, computer games, music, sport and cellphones. The cards can be graphically linked together both actually and virtually to reveal more information and activities. Registration on the website enables visitors to engage in virtual collecting and codes on the actual cards opens new areas of the website giving access to more science facts and suggestions for further discovery. The collectable cards are being released in several nationwide phases throughout 2005 and are available at a variety of distribution points (cinemas, video stores, toy shops, libraries) across the country. A quote from some 'tweens':

> "*SciCards are great fun. They are better than Yu-Gi-Oh cards because they give you info on the world*"
>
> "*WOW!!! I think SciCards are great because they are interesting, scientific and teach us a lot in a fun way … plus they are free which is excellent … PS I love the website*"

And a comment from Napier Public Library:

> "*They are VERY popular. Congratulations*"

The second project is quite different. The link between mathematics and music and design has long been recognised and the synergies accepted. The Dance of Mathematics unwraps these ideas further and shows the mathematics behind the patterns of dance. "The patterns of the dance are geometric, symmetric, repetitive cyclic movements. These ideas are the stuff of mathematics." The project team held six community dances across the Canterbury region followed the next night by a maths 'performance' with lots of demonstrations and participation. Media interest was intense with interviews on radio and television and features in the local press. This project, although relatively small and confined to the Canterbury region, is highlighted because it is an excellent example of a Promotion Fund project - highly creative, edgy and innovative, and as a result immensely successful.

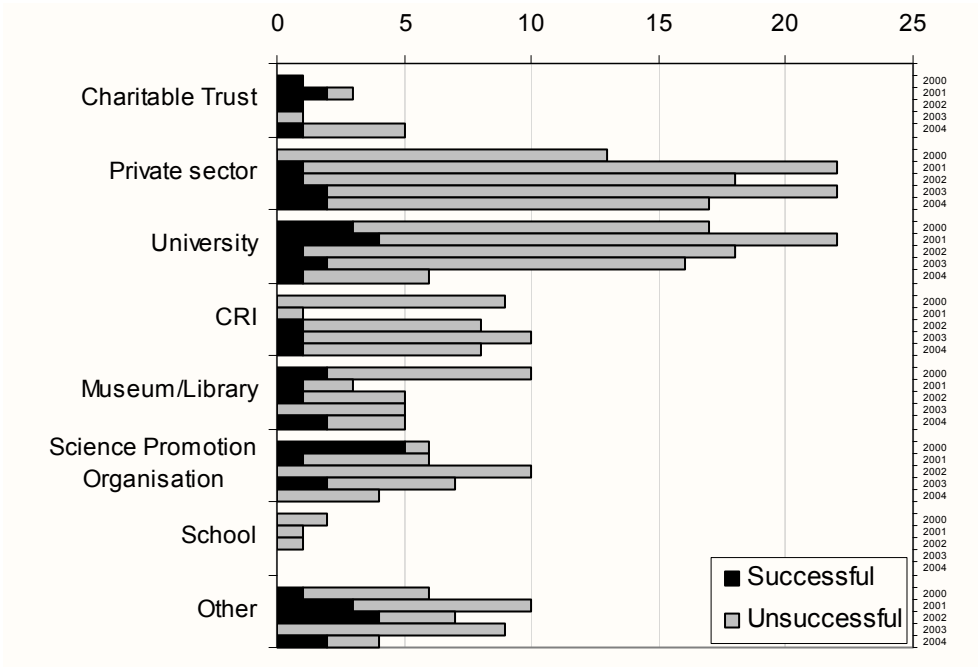
PROGRESS AND ACHIEVEMENTS EVALUATION

SCOPE AND SCALE

In the 2004/5 funding round, nine projects were funded from a total of forty-nine applications. The decline in the number of applications was probably due to the addition of the sponsorship criteria, which required projects to have sponsorship equivalent to grant size. This additional eligibility restriction, reduced the number (and quality) of projects applying for funding.

Providers may be from any institution, group or individual excluding the Royal Society and the Carter Observatory. For the past four years there has been a good spread of projects across different provider groups. The figure below shows the numbers of applications and the proportion of those that received funding.

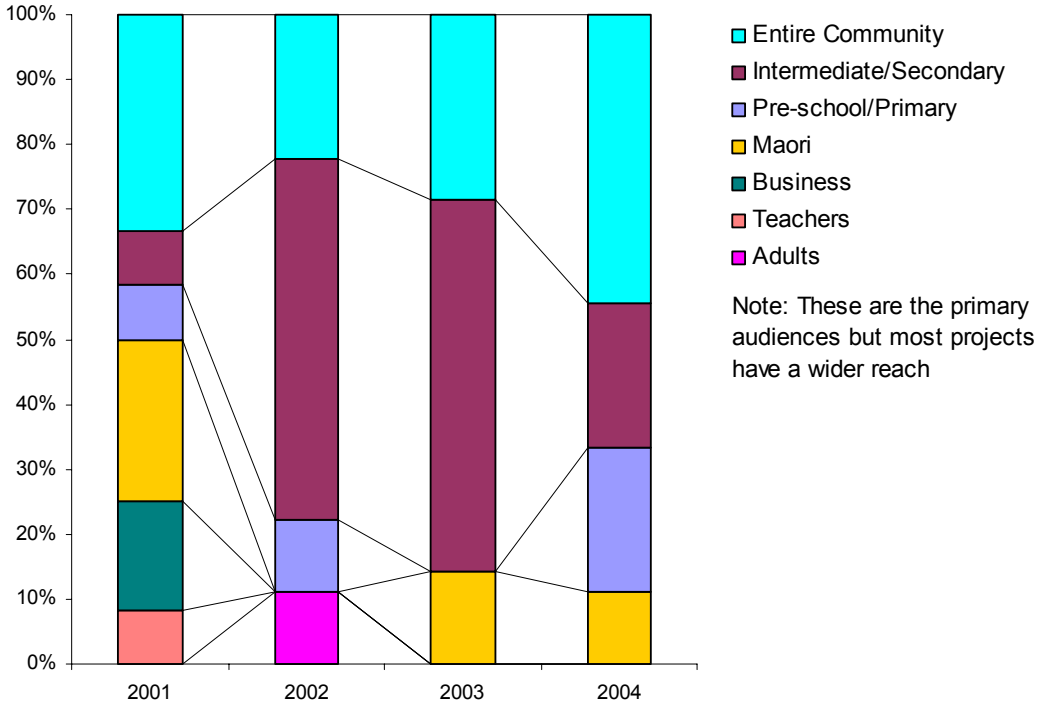
Figure 6. Distribution of applications to the 2000–2004 rounds of the Science and Technology Promotion Fund by provider type



USERS

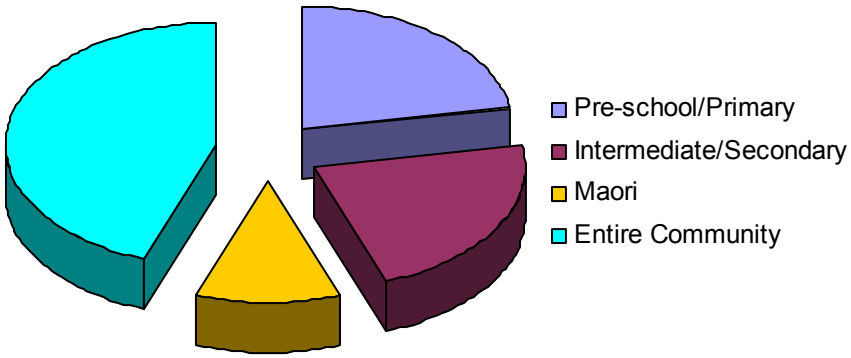
Projects must demonstrate that they will reach an audience that is not already showing a strong interest or understanding of the value of science and technology in achieving success and wellbeing for New Zealand. The table below shows the spread of targeted audience for the last four years.

Figure 7. Primary audience of successful applications to the 2001–2004 rounds of the Science and Technology Promotion Fund



The chart below gives the split for 2004/5 only:

Figure 8. Primary audience of successful applications to the Science and Technology Promotion Fund in 2004/5



HOW MANY PEOPLE REACHED?

The Royal Society has collated estimates of the number of people reached by the six projects funded in the previous year (2003/4) and which have now finished. The following are minimum estimates only; many of the projects have a wider impact beyond the direct participants counted (see Evaluation).

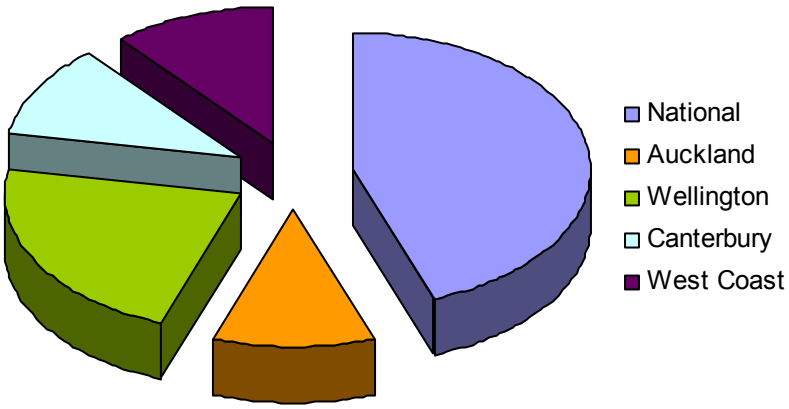
- BioBlitz - 2,500 people attended two BioBlitz events and 10 schools visited in Auckland area
- 262,000 people watched TV documentary showing science behind endurance racing plus DVD distributed to every secondary school in New Zealand and plus two presentations by scientists to 500 students
- Transit of Venus website reached number four on Google's search engine and between February and July more than two million hits registered with page views of 877 per day
- 10,795 students attended a comedy show explaining DNA and DVD of show distributed to schools
- Science pages in teenage magazine read by 200,000 teenagers every quarter over one year
- 138,236 visitors to exhibition of science images normally invisible to the naked eye

In addition, two projects from 2002/3 have had a continued wide audience reach. One is Stonehenge Aotearoa whose website received an average of 19,000 visitors per month in 2005. Since it opened in February 2005 it has received nearly 3000 visitors. The other project is The Science Behind Your Garden which is reaching thousands of New Zealand gardeners through its website which is receiving an average of 3540 hits per month and through its monthly gardening column in Otago Daily Times, Christchurch Press, and four large community papers.

GEOGRAPHIC COVERAGE

Every year, the selection panel endeavours to select projects that provide a balanced geographic coverage. Figure 9 shows the geographic coverage of projects from 2004/5 and demonstrates the continued trend towards national projects becoming predominant.

Figure 9. Geographic distribution of target audience for 2004/5 Science and Technology Promotion Fund projects



MEDIA COVERAGE

Some projects generate a great deal of media coverage, extending their reach beyond the direct participants. Table 6 gives the media coverage from January 2004 to June 2005:

Table 6. Media Coverage from January 2004 to June 2005

Project	Press	TV	Radio
Stonehenge Aotearoa (completed Feb 05) Also featured on BBC website	39 (including Listener and North and South) 5 specialist	TV3 News TV3 documentary 5 news features	Radio NZ x 5 Other x 3 Regular monthly slot
Science Behind Your Garden (to complete end 2005)	13 Monthly column		
'Unseen Worlds' exhibition	18 1 specialist	TV3 News	National Radio x 3
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	8	TV1 News x 2 TV3 News x 2	Radio NZ x 2
'Life's What You Make It' comedy tour	2		Local
SciTech: quarterly science pages in TEARAWAY	Teen mag x 4 x 4 pages		
'100 Hours of Exercise' documentary	5 2 specialist	TV1 Sky x 6 Regional	Radio NZ x 5 Local x 2
Healing the Land (project cancelled)	1		Local
Dance of Mathematics	1		National Radio x 3 Local
E=mc^2 website (as part of 2005 Year of Physics - ongoing)	21	Close Up TV3 News	National Radio x 8 Local
SciCards (ongoing)	5 6 specialist	TV2 x 7	Local National Radio x 1
Undersea Soundscape (in research phase)			National Radio x 1
Bottled Lightning (delayed project start so no media yet)			National Radio x 1

EVALUATION STUDY

In conjunction with the Victoria University of Wellington, an evaluation of the Fund consisting of interviews with the leaders of 10 completed projects and a web-based survey of unsuccessful applicants was completed early in 2005. This evaluation sought to identify: whether funding had led to long-term impacts on the promotions activity of its recipients and the degree to which the Promotion Fund is necessary for the types of activity that it funds.

KEY FINDINGS

The majority (80 %) of funded projects led to promotions activity beyond the term of funding. In the 30 % of funded projects where the funded activity continued beyond the Fund's support, all had been incorporated into the work plan of the host institution. In addition, three project leaders commented that their contract had contributed to the development of new promotions projects.

Where projects were not currently active, the most commonly noted contributing factor was the difficulty in attracting funding for ongoing activities. This concern was also noted by many of the web-survey respondents. In addition, a recurrent theme threading through the evaluation was the difficulty that project leaders saw in obtaining funding for projects that were just beyond the pilot stage and thus no longer eligible for Promotion Fund support.

The Fund is an important enabler for science and technology promotion activities, with 80 % of interviewed project leaders of the opinion that without the Fund's support their promotion activity would either not have taken place, or would have been much reduced in scale. Similarly, responses to the web survey indicate that only a third of unsuccessful applications lead to activity without Promotion Fund support, and where they do so it is typically in significantly reduced form.

The Fund also appears to have flow-on effects on S&T promotion activity as 80 % of interviewees stated their own or their organisation's capability and skills in this area had been enhanced as a result of the Promotion Fund supported project.

Success in attracting Promotion Fund support was seen by many successful, and unsuccessful, applicants as providing a hallmark of excellence to projects, with half of the interviewees explicitly stating that they believed the Royal Society's brand has enhanced their ability to attract supplementary financial support.

The majority of project leaders interviewed saw the Royal Society as the custodian of promotional activities in New Zealand and expressed the desire to see the Society take on a larger role, of which a common request was that the Society maintain a public archive of past promotions projects. However, many of the other activities suggested, e.g. brokerage of projects to potential sponsors and project mentoring, are beyond the scope of the Fund management remit, and it is hoped that the science and technology promotion hub 'Joule' will be active in these areas.

Perhaps unsurprisingly, project leaders who made more applications for funding, and/or were more successful in attracting finance, were more likely to have projects proceed without Promotion Fund help. However, of concern were instances where project leaders had serially sought funding without being able to carry out their projects and as a consequence had moved away from science and technology promotion entirely.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

The Science and Technology Promotion Fund continues to support the most innovative, creative and edgy projects - these projects often tap into the creative arts to open up the world of science to New Zealand's general public (e.g. national comedy show, art exhibition). Others use more traditional promotional vehicles but add an innovative technological or communication element (e.g. $E=mc^2$ website, science pages in teenage magazine). The Fund now gives larger awards and this has enabled stronger, more effective projects to proceed with offering a national reach. This gives greater potential for media coverage but many organisations do not have the capability to access this. It has been noted that where the Royal Society is involved, broader, national media coverage is obtained. Those projects integrated under the Royal Society's major annual themes have benefited from the coordinated services and the consequent attention this has provided (see Stonehenge Aotearoa, Transit of Venus and $E=mc^2$). It was noted from the evaluation study findings that most of those already involved in promotional activity in the sector would like the Royal Society to provide additional assistance. However, this is beyond the scope of the Society's current resources.

Following on from the evaluation, several recommendations were made to MoRST:

- Change reporting requirements to allow presentation of the schemes' highlights;
- Removal of the sponsorship requirement as a criterion; and
- Consideration be given to the need for bridge or continuation funding of existing projects. The Fund is relatively small and is vastly oversubscribed. We are missing out on a lot of very good projects as a result. Further, the ability to continue funding for the most successful projects will be very beneficial to the sector as a whole, deliver excellent value to government and build upon the initial investment by the Fund.

The first two recommendations have been implemented. The Royal Society advises that the third recommendation be put in place. However, this requires two provisos:

- Projects that have received funding in a previous round(s) are allowed to apply again. This will ensure that those projects which would be most effective can continue.
- The Fund already has great difficulty funding all the excellent proposals and many highly promising proposals miss out. As more projects will be eligible to apply, we recommend that the Fund is increased to make the best use of these opportunities.

MANAGEMENT FEE FOR SCIENCE AND TECHNOLOGY PROMOTION FUND

With the above increases, an increase in the management fee is necessary to provide:

- Support for generating media coverage to increase the coverage and impact of projects;
- Increased capacity for increased number of projects; and
- Production and maintenance of up-to-date web pages containing information from past project leaders and assistance to new leaders to allow for ongoing learning to spread between projects.

NEW ZEALAND SCIENCE AND TECHNOLOGY MEDALS

Output Class 6 – Promotion of Science and Technology

Through the medals, we recognise and celebrate our excellent researchers.

OVERVIEW

RUTHERFORD MEDAL

The Minister of Research, Science and Technology recently spoke of the desire to have an annual Prime Minister's Science Award that is prestigious, visible, coveted and widely promoted. There is already such a pre-eminent award, the Rutherford Medal, paid for by Government and the previous Minister, Hon Pete Hodgson, presented the medal to the recipients at the annual Science Honours Dinner in 2003 and 2004.

The Rutherford Medal is New Zealand's premier national award for scientific achievement. It recognises and honours those who have made exceptional contributions to New Zealand society and culture through activities in the broad fields of science, mathematics, social science, and technology. Before 2000 the Rutherford Medal was known as the Gold Medal but it has always been New Zealand's most prestigious science medal.

Since the introduction of the annual Royal Society of New Zealand Science Honours Dinner in 2003, the Society has provided the opportunity to showcase the Rutherford Medal and as a result has increased its profile. However, the Society agrees that the medal could have an even higher profile but this would require extra financial support from Government.

The quality of nominations and recipients over the 15 years since the Rutherford Medal was established is testament to the prestige of the medal. Previous recipients are:

1991 Professor Vaughan Jones DCNZM Hon FRSNZ
1992 DSIR Group Award
1993 Professor Roy Kerr FRSNZ
1994 Dr, now Sir Ian Axford Hon FRSNZ
1995 Professor William Denny ONZM FRSNZ and Auckland Cancer Research Laboratory
1996 No award
1997 Emeritus Professor Thomas (John) Walker
1998 Dr William Robinson FRSNZ
1999 Professor David Vere-Jones FRSNZ
2000 Professor Alan MacDiarmid ONZ FRS Hon FRSNZ Nobel Prize
2001 Professor Peter Gluckman CNZM FRS FRSNZ
2002 Professor Jeff Tallon FRSNZ
2003 Professor George Petersen ONZM FRSNZ
2004 Professor David Penny FRSNZ

SILVER AND BRONZE MEDALS

Silver and Bronze Medals also belong to the suite of New Zealand Science and Technology Medals instituted by the Royal Society of New Zealand at the request of the Government. These Medals are also paid for by Government.

Silver Medals are awarded to honour men and women who have made excellent contributions to the fields of science, mathematics, social science, and technology.

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.

HIGHLIGHTS

The 2004 Rutherford Medal was awarded to Professor David Penny FRSNZ of Massey University.

Born in Taumarunui, New Zealand, Professor Penny studied Chemistry and Botany at the University of New Zealand (Canterbury University College), before receiving his PhD from Yale University. In 1966, he returned to a lecturing position at Massey University, where he is still located.

Within the area of Molecular Bioscience, Professor Penny's research interests are diverse, and include:

- developing new mathematical methods for evolutionary trees and the analysis of DNA;
- studying the evolutionary process, and investigating the evolutionary history of birds and plants;
- researching the origin of life;
- investigating patterns of human origins and dispersal, including human origins and the peopling of the Pacific.

The excellence of Professor Penny's work, and the group that has developed around him, was the basis for the establishment of the Allan Wilson Centre for Molecular Biology and Evolution at Massey University in 2002, of which Professor Penny is the Research Director. The group continues to provide a training ground for biologists and has active, strong reciprocal links with numerous overseas laboratories.

Professor Penny was formally presented with the 2004 Rutherford Medal by the Minister of Research, Science and Technology in the presence of over 200 scientists and technologists at the Royal Society of New Zealand Science Honours Dinner held in Christchurch in November 2004.

EVALUATION

In 2004 there were four nominations for the Rutherford Medal, and 16 nominations for Science and Technology Medals. One Rutherford and five Bronze medals were awarded. These medals were presented at various local ceremonies around the country during the latter part of 2004.

In recent years, particularly the last 3 years, the Rutherford Medal has taken on even greater prestige, and as a result more excellent nominations are being received for it. At 30 June 2005, four outstanding nominations had been received for the 2005 Rutherford Medal.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

RUTHERFORD MEDAL

The Royal Society proposes to further raise the profile of the Rutherford Medal by:

- holding the announcement of the award until the Science Honours Dinner. We are doing this for the first time in 2005 and believe the "surprise" element will encourage much more media interest;
- attaching a monetary award to the Medal;
- lodging a large eye-catching advertisement in national papers announcing the winner of the Medal;
- developing the Science Honours Dinner into an even grander affair with considerably more media exposure;
- having the expectation of a further public role for the medallist during the year following the award. At present the medal is awarded and the winner goes back to his research bench without necessarily any more media exposure. If the winner was required to give some relevant public lectures under the umbrella of the Rutherford Medal during the year following the award this would keep the profile of the award high and act as raiser of awareness for science in general.

For comparison, the Prime Minister's Prize for Science in Australia, awarded for an outstanding specific achievement in any area of science advancing human welfare or benefiting society, comprises an embossed gold medallion, a lapel pin, and a grant of $300,000.

PICKERING MEDAL

Currently there is no prestigious Government-funded Technology Medal. In 2003 the Royal Society introduced the Pickering Medal to recognise excellence and innovation in the practical applications of technology and recommended to the Ministry that it consider adding the Pickering Medal to the suite of New Zealand Science and Technology Medals. The Royal Society also suggested that funding of the medals be increased to cover costs of striking the new medal and to cover costs relating to additional publicity and Royal Society administration.

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 prestige of the pre-eminent Rutherford Medal is well recognised but it might be best to rejoin the Silver and Bronze Medals and call them Science & Technology Medals.

SCIENCE AND TECHNOLOGY PUBLICATIONS

Output Class 7 –Science and Technology Publications - $542,000 in 2005/6, inclusive of GST

GOVERNMENT-OWNED JOURNALS PUBLISHED BY THE ROYAL SOCIETY OF NEW ZEALAND

The global change in publishing models is making the current position of the journals unsustainable.

OVERVIEW

A basic tenet underlying all research that is that it must be published for it to be valid and meaningful. The national science journals published by the Royal Society of New Zealand exist primarily to fulfil that function.

In addition, the journals make New Zealand's current research efforts available for use now. Past issues contain the history of all the research that has underpinned the development of this country.

New Zealand needs its own national research journals because they:

- provide a means of validating research of benefit primarily to New Zealand researchers
- maintain the credibility of New Zealand science internationally
- raise the scientific profile of New Zealand, and help attract world quality researchers to work in New Zealand
- complete the scientific process undertaken by New Zealanders
- are a measure of New Zealand's scientific progress
- promote a sense of community in New Zealand's scientific scene
- foster contact between New Zealand researchers and those working overseas
- preserve New Zealand's scientific knowledge
- provide a database for future progress
- provide a vehicle of publishing papers primarily of regional interest and value
- are ridiculously cheap to publish in comparison to the cost of undertaking the research itself

Government partly supports the publication of eight New Zealand primary research journals, through an annual grant to the Royal Society. The journals are government-owned and published by the Royal Society. They are largely regional in scope but have a global audience, particularly within the Southern Hemisphere and western Pacific United States. 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
Kōtuitui: New Zealand Journal of Social Sciences Online

The Society has been responsible for publishing the journals since the disbandment of the DSIR in 1992. It has maintained the international value and credibility of the journals, and adopted a flexible and forward-looking attitude to the global changes in publishing that continue to occur.

OPEN ACCESS

In the next few years, science journal publication is expected to move away from traditional printed journals filling the shelves of subscribing libraries, to a system of searchable, online articles at the disposal of anyone with an internet connection. To some extent, this exists now, but in a very haphazard and poorly regulated way. Print subscriptions exist alongside internet access, free and subscribed, commercial and open access. Future journals may exist only as individual articles, perhaps mounted on the author's own website. Regardless of what the final format may be, one factor remains irrefutable—that is, the role of the publisher will remain central in providing a recognisable mark of validation and quality to an otherwise anonymous piece of work. By continuing in its role as publisher of New Zealand's research efforts, the Royal Society will ensure that the value of New Zealand science internationally will not be diminished.

Open access requires that publication be funded ultimately by the government, or funding agent, as author charges. Present governmental funding of the national journals covers only one-third of their costs, but under full open access, there will be no subscription revenue. Possible future funding scenarios under different charging and operational options are presented below.

HIGHLIGHTS

NEW SOCIAL SCIENCES JOURNAL

Kōtuitui: New Zealand Journal of Social Sciences Online was established this year in response to encouragement from the Social Science community and with funding from MoRST. This journal is an open access, peer-reviewed journal of top-flight social science inquiry and research across all social science disciplines, and will promote connections among all research communities. Being open access, journal articles will be freely accessible from the journal website, facilitating the wide distribution of New Zealand social science knowledge, both nationally and internationally.

Editorial and administration processes for Kōtuitui is based within research institutions using the Society's journal management system, and a system of honorary editors and associate editors and with the assistance of an Editorial Advisory Board. This journal is a electronic only and will provide useful indicators for the other research journals as they move towards full open access.

PUBLISHING HIGHLIGHTS

Papers of special significance:
1) *New Zealand Journal of Agricultural Research* published a special issue in 2004 entitled "Land application of farm wastes". The issue was particularly timely, coming out very soon after a report by the Parliamentary Commissioner for the Environment on the same general topic. An Editorial Advisory Board member has commented:

> *"The special issue on farm wastes was both topical and timely and served to draw together recent and on-going research into the principles and practices of dealing with farm wastes to obtain the benefit of the nutrients and organic matter they contain while ensuring the minimum loss of nutrients and disease organisms to ground and surface water bodies in particular. The special issue brings similarly themed research on a singular topic together in one place and so serves to better inform researchers and practitioners of the current state of knowledge, where the gaps in knowledge are and where progress can be made in the future."*

2) Three extra issues of *New Zealand Journal of Marine and Freshwater Research* were published between August 2004 and July 2005. These three issues were fully funded. They represent proceedings of conferences, regional and international. All three issues are available online on an open-access basis.

Special issue on invasive species - (NZJMFR Volume 38/Number 3/August 2004; pp. 383–567)
Proceedings of the Australian Society for Fish Biology (ASFB) workshop on invasive species relating to fish and fisheries held in Wellington in 2003.

The published proceedings represent the collaboration between Australia and New Zealand with the addition of international perspectives. It aims to raise the awareness at political, departmental, and community levels of the potential serious environmental problems associated with invasive fish species and identifies priority recommendations to improve the management of invasive fishes in Australia and New Zealand.

> *"Publishing in NZJMFR represented a very good investment for ASFB with the professional production of refereed papers in a quality scientific journal adding to the value of the workshop and papers. The journal also offered increased circulation of the papers to a wider global audience not so easily accessed by the Society."*
>
> Richard Allibone, ASFB Conference and Workshop Committee Chairman 2003

Other special issues were published on lobster biology and management.

NZJMFR – international journal of aquatic sciences – responses to special issues

> *"The special issues on "Invasive species" and "Lobster biology and management" are superbly produced and are of great interest here in North America. They will be very effective in raising the international profile of the New Zealand Journal of Marine and Freshwater Research."*
>
> Professor Warwick Vincent, Université Laval, Canada

PROGRESS AND ACHIEVEMENTS EVALUATION

The impact factors of the journals continue a general trend upwards and the rankings remain strong. The New Zealand journals continue in their vital role, but are under financial pressure from the mismatch between income and open access demands.

The journals play a significant part in New Zealand research, disseminating a growing number of papers, 543 papers submitted and 345 published, with further details in Appendix 13.

The journals continue their significant impact, as shown in Appendix 15, and their strong rankings, as shown in Appendix 16.

LAUNCH OF THE NEW SOCIAL SCIENCES JOURNAL

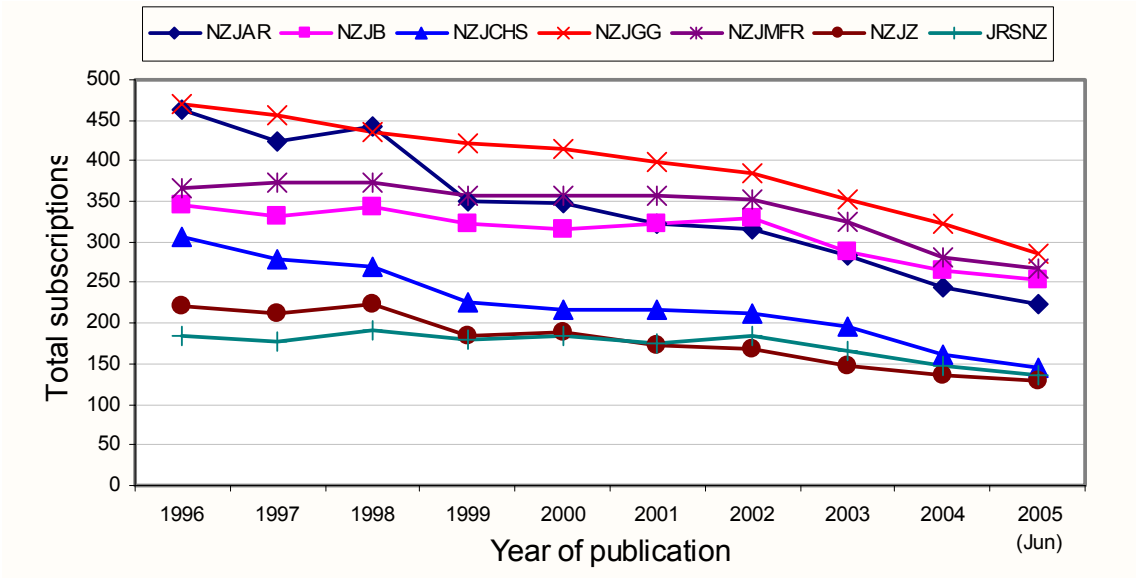
This journal was newly established in June 2005 and already a good number of submissions (15) have been received, and this bodes well for author support. However, page charges for the first year have been waived, as social scientists have shown resistance to page charges.

However, the viability of the journal suffers the same concerns as for all the journals. Currently the Society subsidises their production. The decline in the subscription-based business model to the open access model means the Government must support the publication costs. It can do so either through direct support of the publishing unit, or through explicit increases in research grants, with the Society covering its costs through realistic page charges. We await a decision on this question.

A NEW BUSINESS MODEL

Over the last ten years, subscriptions have been declining. This follows the global trend of replacing individual subscriptions firstly with institutional subscriptions, and later with open access. Journal budgets over the last ten years have shown a 34 % reduction in the number of subscriptions from 1996 to 2004 (2357 to 1560) as shown in Figure 10.

Figure 10. Subscription levels for the Royal Society journals from 1996–Jun 2005



The current level of budget deficit is caused mainly by the long-term decrease in subscriptions as the world moves to open access. The stark effects of reduced journal subscriptions as the journals become available online, despite the limited system of page charges currently in place, shows the unsustainable nature of the current situation. Only full-cost governmental funding will enable full open access publication to be realised. A sudden move to a realistic page charge would be unlikely to be supported by authors, unless they in turn were supported by Government.

BUDGET 2005/5

We present four cases below, representing possible different income options where only online publishing is used. The following cases use the current figures for current page charges of $50, up to a maximum of $500 per article. Page charge waivers are given to 30 % of authors, and 25 % of authors are foreign.

Case 1: The current unsustainable situation for 2005/5

Income:
Current MoRST support
Page charge income
Sundry sales
Required extra income, comprising:
Subscriptions

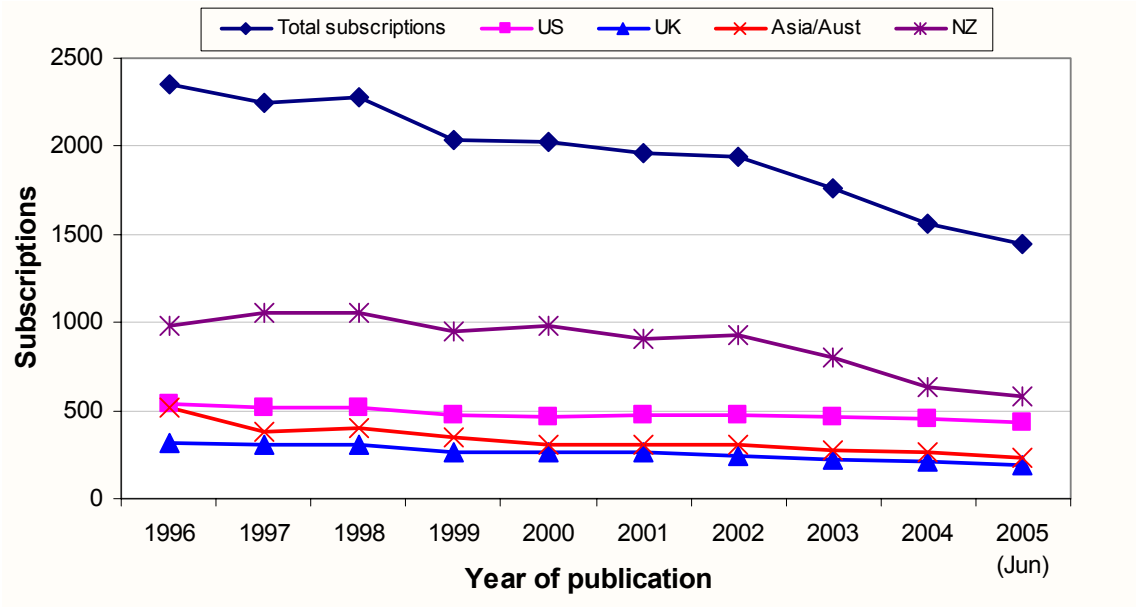
Expenditure:
Production costs
Printing and posting

Currently, income is less than expenditures, resulting in a deficit per year. If the current situation continues, the Society will be forced to take actions to contain costs, such as not producing the printed journals and reviewing subscription charges.

The current extra income shown above comes from subscriptions. However, these subscriptions are declining. The breakdown of sales by country (Figure 11) shows that the decline is universal, though the biggest drop is from

within New Zealand itself, which has traditionally had a large individual subscriber base. These individuals now enjoy the benefits of free access to information via their institutional subscription.

Figure 11. Subscription levels for the Royal Society journals from 1996–Jun 2005 by region



Case 2a: Open access, full page charges for all, online publishing only

Income:
MoRST support
Full page charge income

Expenditure:
Production costs without printing

Case 2b: Open access, free to publish, online publishing only

Income:
MoRST support
Full page charge income

Expenditure:
Production costs without printing

In these cases, no subscription income is received. In case 2a, all income comes from full pages charges for all authors. Over the last five years we have published an average of 4175 pages per year; hence the page charge would come to $253 per page. This is a dramatic increase over the current $50 page charge. Government would support publishing by including publication costs as an overhead in awards to researchers.

In Case 2b, all publishing income comes from direct support to the publisher. The cost to the Government is the same as in Case 2a.

This situation raises the policy question – should the publication costs of journal articles be paid for by a subsidy to a publisher, or through explicit support built into grants from investment agencies? The direct route offers the most transparent, low overhead system and covers researchers not in receipt of grants. It also maintains a New Zealand-based publishing and reviewing capability and provides a locus for research specifically relevant to New Zealand.

Explicit support may experience operational difficulties of matching increases in many different grants with potentially variable costs to authors on publication. However, the explicit support route maintains pricing signals and allows authors to choose which journals are most relevant to their work. If an explicit route is chosen, another mechanism will need to be found to support authors who currently would receive page charge waivers.

Were full page charges to be introduced suddenly, prices would increase by a factor of five. This price shock would be very detrimental to the journals. Full page charges, if they are applied suddenly, will seriously affect the level of submissions. This is especially true for social sciences, as page charges are not part of the social science publishing culture in New Zealand.

As well as the risk of too sudden a change, there is also the risk of too early a change. There are moves to page charges across the globe, but if Society imposes realistic page charges, i.e. greatly increased ones, at a time when some overseas journals are still subsidised by their own governments, we would make the publishing capacity within New Zealand uncompetitive.

Hence we recommend that subscriptions are phased out over a period of time, being gradually replaced by direct support for the publisher or by full page charges.

Case 3: Open-access - the target situation after subscriptions and printing are phased out

Income:
Page charge income at $253/page for non-waivered authors
Support from MoRST for page charge waivers

Expenditure:
Production costs without printing

Assuming that Government chooses to use full page charges, this will be the situation once those full page charges are phased in, replacing subscriptions completely, allowing all research published in the New Zealand journals to be accessed free by all.

This case includes page charge waivers, discussed further below.

However, a separate question is the phasing in of this change, to avoid price shocks or mismatch between page charge costs and page charge support in grants. We discuss this question next.

Case 4: Proposed situation for next year – phasing in of page charges, phasing out of printing

Income:
Page charge income at $70/page for all non-waivered authors
Decreasing subscription fees
Support required from MoRST, comprising:
Current support
Increase in support

Expenditure:
Production costs without printing
Phasing out printing

In this case, the current page charges increase to $70 and the $500 cap is lifted for long articles, as the start of a phased-in increase to full costs. Subscriptions also begin to be phased out and we assume that they decrease to half their current level. The increase in page charge income does not fully compensate for the loss of subscriptions.

This case assumes that foreigner researchers are charged the $70, not the full page charge. The lost page charge income is an effective subsidy to those researchers. Obviously, if full page charges were levied on all foreign researchers, the MoRST contribution would be decreased, depending upon how many foreign researchers were discouraged by the six-fold increases in prices.

We plan to phase out printing by January 2007. Printed copies will still be available to those that require them. These will be printed on demand, at a higher unit cost and full cost recovery.

PAGE CHARGE WAIVERS

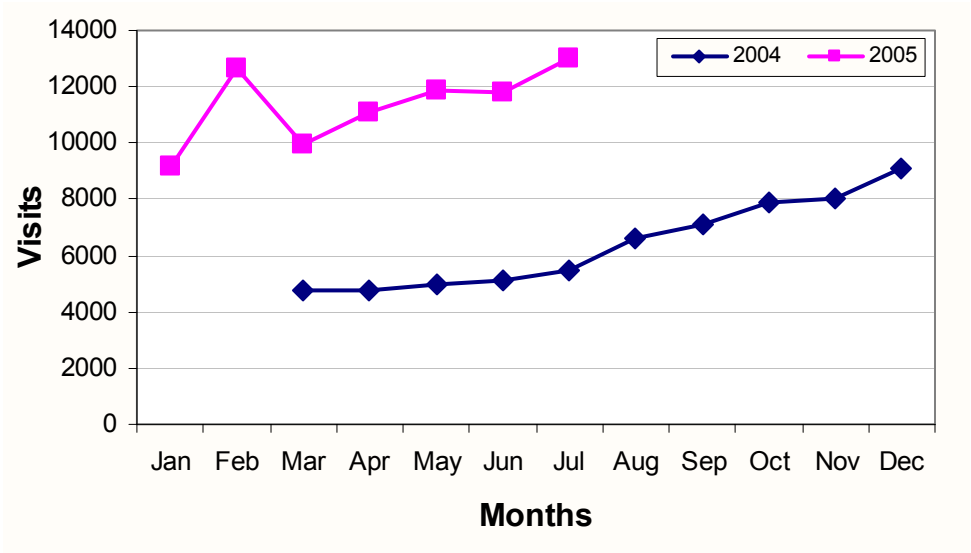
In the second year of page charges, 30 % of authors had charges waived because there were no funds available for publishing the research, or because of personal hardship. This was the same as in 2003. Many of these researchers are retired scientists, working with very low overheads. They provide a deeply-experienced, cost-effective resource for New Zealand's science. However, they cannot bear the costs of full page charges. Page charge waivers allow these people to continue to publish peer-reviewed research.

GROWTH IN ELECTRONIC PUBLISHING AND PROCESSES

The average monthly number of visits to the publishing web pages during 2004 was 6338. For 2005, average number (to July) was 11355. In general, the number of visits is increasing every month. This reflects the growing usage of the journal pages that have been made available through online publishing and the digitisation of back issues. As subscriptions to print copies have declined, the number of visits to the online journals has increased.

Another popular site is the Track Manuscript page, whereby authors can follow the progress of their paper through the review and production process.

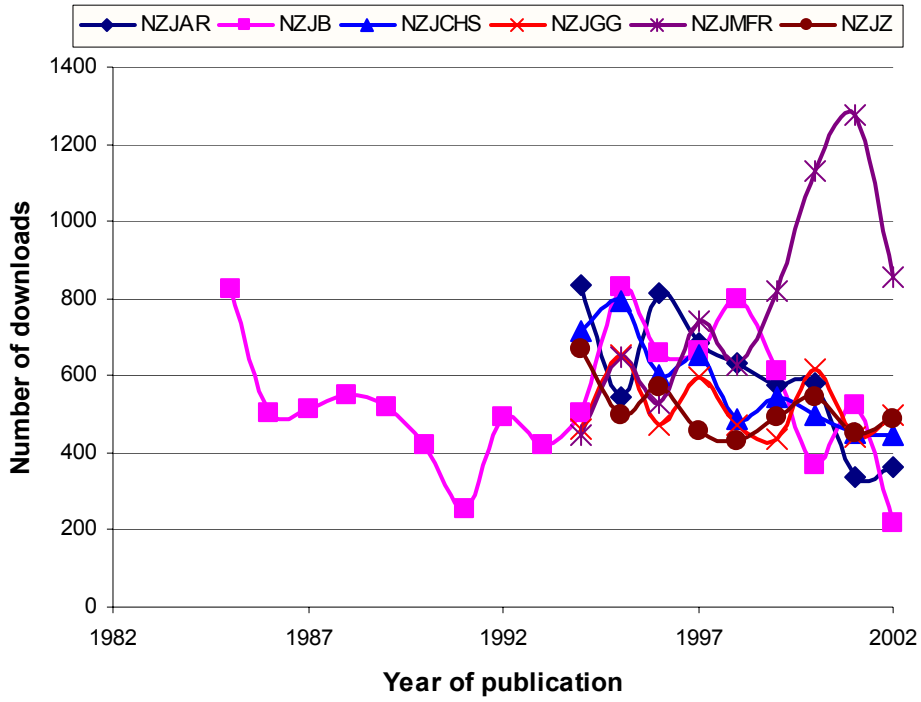
Figure 12. Number of visits to the Publishing sections of the Royal Society website from March 2004–July 2005



DIGITAL ARCHIVES

In line with current moves towards open access and with international trends in online publishing, we are making the contents of the Government's journal back issues available in digital, searchable format (Abode Acrobat PDF) and all online journals freely available after two years of publication. With external funding provided through the DoC Terrestrial and Freshwater Biodiversity Information System (TFBIS) Programme, we have converted back issues of all journals back to 1994. In addition, all issues of New Zealand Journal of Botany were digitised to Vol. 1 (1963) and New Zealand Journal of Marine and Freshwater Research have been digitised to Vol. 4 (1970).

Figure 13. Number of downloads of NZ Journal articles in 2004/5 by the articles year of first publication



The use of the archives shows a continuing interest in the older papers. Evidence shows a high demand for articles going back at least twenty years and no evidence of a decline in interest with age. This may be due to the difficulty of obtaining paper copies of the old journals.

Bibliographic studies also show that the journals have a long citation half-life, of around ten years. This suggests that digitizing older articles will be of increasing benefit to researchers.

However, without continued funding, the conversion of issues of the remaining journals will not happen.

NON-JOURNAL PUBLISHING

The Society publishes additional books and bulletins as needed, usually fully funded projects from conference proceedings or discussion documents. No MoRST funds are used in these publications. The activity constitutes an important extension to the work of the Publishing unit and adds credibility to its name as a major publisher of New Zealand science. There is a constant demand for many of these publications that have been produced in the past.

STRATEGIC DIRECTION AND POLICY RECOMMENDATIONS

Open Access Business Model

In 2005-06 the Royal Society will subsidise the government-owned journals. The open access publishing model has been chosen for its benefit to New Zealand research. The journals need to be put on a sound financial footing, with support that matches the open access publishing model.

By publishing these journals, the Royal Society of New Zealand is fulfilling one of its main strategic aims: support of New Zealand's science and technology community. In addition, by developing an emphasis on the Southern Hemisphere generally, the journals are usefully extending the viability of local research to more researchers elsewhere. The journals are government owned and published by the Society on their behalf, yet government funds only approximately one-third of their costs. Remaining costs are met by subscriptions and author page charges, but

these are insufficient to cover the costs fully, subscriptions are declining and many authors with no access to funds for publication are granted page charge waivers.

Recommendations:

- Government take responsibility for open access publishing by providing sufficient funding to cover the full publication costs, through support for the journals or through support to researchers for full page charges, and cover the cost of page charge waivers.
- With the ongoing decrease in subscriptions, we will be phasing in increased page charges. However, to limit the size of this increase, to treat foreign researchers equally and to provide for page charge waivers, we request additional support.

Digitising archives

Open access to archival material increases the utility of that information, which has a long useful life. Digitising back issues of the journals has been shown to be an important extension of our support to the nation's researchers, with demand for articles increasing with the age of those articles. This activity is presently stalled by a lack of funds.

Recommendation:

- Government will provide funds to enable the digitisation of back issues to continue. Digitising the journals at a rate of one decade per year would be complete in two years.

The Society is broadening the scope of the journals. The current establishment of the new journal Kōtuitui: New Zealand Journal of Social Sciences Online is an example of this. However, there is further potential for publishing in other important areas of research for which New Zealand researchers are not presently catered (e.g., Biosecurity). The Society will continue to evaluate the need for creating new national journal titles.

To promote science and technology to the public and the science community in general, the Society will continue to produce non-journal publications such as conference proceedings and refereed scientific monographs in our Miscellaneous and Bulletin Series, as well as other books, newsletters and magazines. The Society will actively seek opportunities and assess proposals for non-journal publications on a fully funded basis. The Society will also perform a cost/benefit analysis for producing a new Science Digest style of magazine for Society members and other interested readers.

ALPHA AND GAMMA PUBLICATIONS

Output Class 7 –Science and Technology Publications - $75,000 in 2005/6, inclusive of GST

OVERVIEW

ALPHAS

The Alpha series is primarily designed to support the learning of science, mathematics and technology in the national curriculum and are a potential resource for the general public, tertiary institutions and libraries. The Alpha is now produced in full colour, 8 A4 pages, and written by acknowledged experts in the subject area. Free with recent Alphas are extensive teacher notes and student activities, generally written by teachers for teachers and students.

GAMMAS

Each Gamma consists of four A4 pages. They are produced five times a year and are based on current issues that emerge in the media and become part of public debate. The Gammas are produced quickly, presenting current information in a non-judgemental manner. The topics however do remain current as most issues reappear with regularity.

No new publications were translated into Māori.

EVALUATION

All Alphas and Gammas are now freely available online in addition to being available through subscription or one-off sale. While many customers prefer quality productions which are relatively inexpensive, and so print copies are still ordered, these publications have seen increased distribution and longevity through being provided in an open access form.

ALPHAS:

Five Alphas were produced during 2004/5:

Alpha 121 'Michael Walker Te putaiao me te Moana' (in te reo Māori); and,
Alpha 122 'Michael Walker Scientist and the Sea', by Lynley Hargreaves
Alpha 123 Fresh water aquatic plants by Tracey Edwards, NIWA
Alpha 124 Stonehenge by Kay Leather, Richard Hall and Geoff Dobson
Alpha 125 Frogs at Risk by Phil Bishop, University of Otago.

Table 7. Alphas distribution:

	Average downloads per month	Total downloads in 2004/5
Alpha 121	**34**	**336**
Alpha 122	**40**	**403**
Alpha 123	**27**	**82**
Alpha 124	**87**	**435**
Alpha 125	**42**	**42**

Approximately 900 schools and teachers received copies of each Alpha via the NZ Association of Science Educators. In addition, older Alphas continue to be popular, with all available back issues receiving in excess of 260 downloads during the year. The most popular issues, Alpha 120 "Unlocking the ice house - Antarctica and its role in climate change" (2004) and Alpha 104 "New Zealand's alpine fault" (2000), were accessed 916 and 907 times respectively, this despite Alpha 104 being over five years old. In total, 12 473 Alphas were downloaded in 2004/5.

GAMMAS:

The following titles were produced: *Dangerous chickens – the (Asian) bird flu epidemic*, *Lead and you*, *Osteoporosis*, *Tsunami* and *Xenotransplantation; the potential and the perils*.

Table 8. Gammas distribution:

	Average downloads per month	Total downloads in 2004/5
Dangerous chickens the (Asian) bird flu epidemic	**151**	**1814**
Osteoporosis	**67**	**268**
Lead and you	**75**	**528**
Tsunamis	**112**	**559**
Xenotransplantation	**159**	**317**

83 print copies are distributed as each new Gamma appears. As with Alphas, the Gammas continue to attract interest well beyond their initial publication, e.g., 'Drugs in sport' (2000) and 'Drinking water ' (2004) were accessed 2884 and 1015 times, respectively, while the entire series saw 12 504 downloads throughout the year.

SPONSORSHIP

The University of Auckland sponsored the joint production of Alpha 121/122 on Michael Walker. NIWA supported 123 in kind through providing the manuscript as did the University of Otago for 125.

POLICY IMPLICATIONS

The production of Alphas and Gammas is another example of leverage of Government support to gain private sponsorship. The amount provided through the Output Agreement enables us to win sponsorship support. We believe this type of partnership to be extraordinarily effective in deriving maximum benefit from Government money. We are however finding it difficult to secure similar support from organisations which would allow us to produce resources in te reo Māori, and so have not, this year, managed to do so. It is for this reason that we seek MoRST input, in the belief that we will be able to gain external support once we have established a track record. We have been able to produce resources in te reo through the Ministry of Education LEOTC National Waterways Project, but this cannot contribute to the production of Alpha or Gamma series.

We continue to think about developing web interactivity for our resources - links from key words in text to other pages, but do not have the resource to allow us to do this. Ultimately it is our goal to have such interactive links embedded in our publications.

BUDGET RECOMMENDATIONS

We recommend finance towards translation of an appropriate Alpha into Te Reo Māori, and distribution to all Kura Kaupapa and schools with immersion classes to encourage wider responsiveness to S&T in NZ, and support for staff to enable us to develop the web interactivity that we would like to develop.

OTHER INTERNATIONAL ACTIVITIES

Output Class 8 –Royal Society International Memberships and Related Activities- $329,000 in 2005/6, inclusive of GST

OVERVIEW

The Royal Society has many international linkages through being New Zealand's adhering body to 32 international science unions and associates, its MoUs, and through the MoRST international counsellors. The Society is dedicated to ensuring that New Zealand's scientists and technologists are engaging with the best scientists worldwide so they remain at the forefront of world-class science. We work closely with the leading scientific organizations around the world, over science policy and to promote collaboration. We have close links with most international academies of science and we work with these international partners to discuss science issues and to promote exchanges and joint scientific studies.

New Zealand is a country with a relatively small but sophisticated scientific community, far from the main centres of scientific and technological endeavour and deriving much benefit from international scientific and technological contacts.

HIGHLIGHTS

Through the funding provided by MoRST in 2004-05 the Society was able to:

- Provide funding to 18 international conferences held in NZ;
- Provide funding to 6 workshops/symposia held in NZ;
- Adhere to 32 scientific unions or associates;
- Provide partial funding to 10 delegates to attend their respective general assembly and/or congresses;
- Maintain the Co-Lab website that offers European information and opportunities to the NZ research community.

INTERNATIONAL CONFERENCE FUND

On behalf of MoRST the Royal Society provides funding to assist organisations and institutions to host major international conferences in New Zealand. International conferences held in NZ enhances NZ's research, science and technology credibility, promotes international recognition of NZ as a centre for innovation, and assists researchers to develop relationships with world leaders in their respective research areas.

Since its inception in 2003-04 the Fund has supported 17 conferences. There have been 1,543 New Zealander participants and 2,089 international attendees.

The following are two samples of the conferences that received financial support in 2004-05:

International Conference of Bioinformatics
The International Conference of Bioinformatics (InCoB) is the official conference of APBionet and is held biennially. Hosted jointly by the Allan Wilson Centre for Molecular Ecology and Evolution and the Bioinformatics Institute, the conference was held from 5-8 September at the Aotea Centre, Auckland. In total 140 international delegates attended the conference and the list of participants included scientists from Australia, Canada, China, Japan, Malaysia, Singapore, South Korea,Taiwan, Thailand, Vietnam, the United Kingdom, and the USA. Preceding the conference was a workshop on parallel computing, held at the Albany Campus of Massey University in Auckland.

International Conference on Advanced Materials and Nanotechnology
The International Conference on Advanced Materials and Nanotechnology (AMN-2) was held during 6-11 February 2005 in Queenstown. The purpose of the conference was to promote international collaborations in the broad areas of advanced materials and nanotechnology, with a particular emphasis on new and emerging technologies. The conference was attended by more than 350 delegates from around the world (including more than

150 from New Zealand and almost 100 students). It was one of the largest and most successful materials science conferences ever held in NZ. Featured speakers included Nobel laureates Professor Alan MacDiarmid and Professor Klaus von Klitzing, who were joined by 30 other plenary speakers. A further 159 oral presentations were given during 5 parallel sessions spread over two days, and 131 posters were presented. The unusual format of the conference also drew numerous compliments from overseas visitors - three days of plenary sessions where speakers were encouraged to address their talk to the broad audience of chemists, engineers, materials scientists and physicists, followed by two days of parallel specialists sessions. AMN-3, the third of what has become a continuing conference series sponsored by the MacDiarmid Institute for Advanced Materials and Nanotechnology (A New Zealand Centre of Research Excellence), is planned for early 2006 in Wellington.

INTERNATIONAL SCIENTIFIC UNIONS

The Society maintains links to the International Council for Science (ICSU) and its constituent bodies and committees. The principal objective of ICSU is to encourage international scientific activity for the benefit of mankind by initiating, designing and co-ordinating international scientific research projects. It also acts as a focus for the exchange of ideas, the communication of scientific information and the development of standards in methodology.

At present 13 New Zealanders hold positions on international unions, scientific associates or commissions.

CO-LAB WEBSITE

The Society is establishing itself as the New Zealand centre for international R&D information. It provides information to New Zealand RS&T stakeholders on international innovation policies and opportunities by way of the Co-Lab website and monthly targeted electronic newsletters. The website is continuing to be very successful with an average of 12,350 page views per month.

The Society also has a close liaison with New Zealand International S&T Counsellor based in Brussels.

PROGRESS AND ACHIEVEMENTS EVALUATION

All international activities of the Society have an input into the overall global connectedness, not only for MoRST, but for the whole of the NZ science community through its membership to international science unions and associates, and its MoUs. International links are viewed as extremely important as they enable NZ to gain access to and to share information, resources, data banks, colleagues, equipment, programmes, technologies, funds, and techniques. This access to resources develops NZ'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.

The Society was also responsible for the NZ-wide logistics and escorting of the Marie Curie Delegation from Europe, as well as administering the Julius von Haast Fellowship Award culminating in a Award recommendation to MoRST.

Lastly, MoRST currently funds only those web pages concerned with Europe on the CoLab website. We propose that MoRST fund all international intelligence on the site.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

The international-related work of the Society is quite wide-ranging as it continues to ensure that NZ RS&T remains high on the world stage. With this comes an ever increasing cost and the Ministry must ensure that if this is to continue to be developed then it must provide increased funding. One example is that the membership of the Scientific Committee on Antarctic Research (SCAR) is to increase by $US3,500 to $US 14,500 in 2006. Subscriptions of non-governmental international scientific unions and other organisations continue to rise each year. The Royal Society carries the currency exchange risk in the payment of subscriptions. The forecast is for higher exchange costs in 2006-07.

The Royal Society also sees great value in developing Memoranda of Understanding (MoU's) between scientific organisations and NZ. MoU's help to support visa applications for foreign scientists to work temporarily in NZ. However, more resources allocated to activities that take place under MoUs would allow more tangible outcomes, such as bilateral seminars, travel grants, and student exchanges, raising the profile of NZ research. These additional activities will require an additional 0.65 FTE.

At present the Society receives government funding designated to three key areas - international memberships, the transfer of international information and opportunities, and international conferences held in NZ. The cost of the international memberships increases by approximately 5 % each year and are also dependent on the fluctuation of the currency exchange rate.

If New Zealand is to acquire a greater presence on the international stage in these important areas and to allow increased flexibility then a larger pool of funding is required. It is recommended that funding be increased to reach $400.0k by the year 2010. In addition to the annual rise in international membership subscriptions this recommendation would permit the Society to have some small discretionary funding for use in various areas of international-related promotion.

THE ROYAL SOCIETY OF NEW ZEALAND
PROGRESS AND ACHIEVEMENTS REPORT

APPENDICES
OCTOBER 2005

Promoting excellence in science and technology

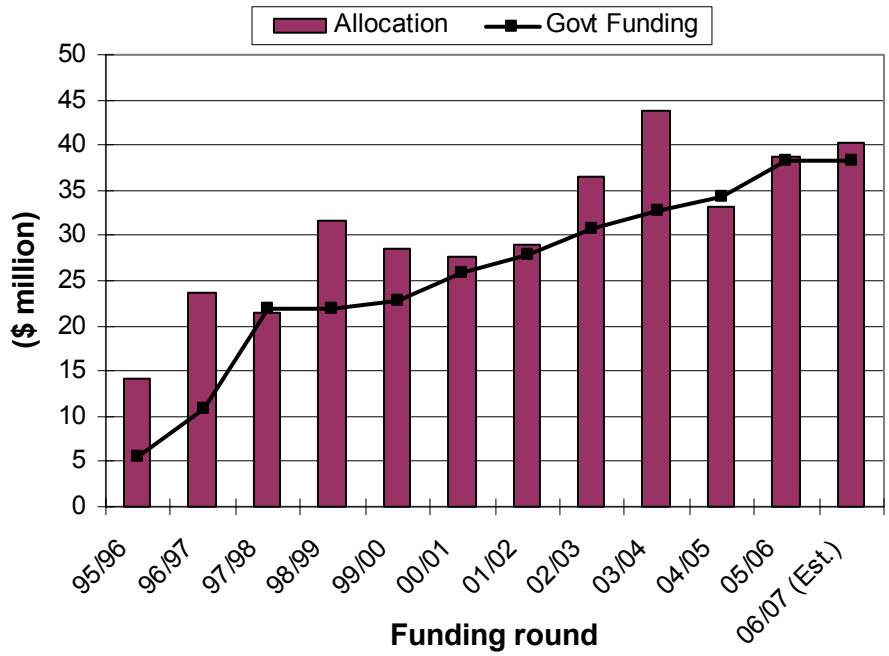
PART C – EVALUATION DATA

APPENDIX 1. MARSDEN FUND – SCOPE AND SCALE

The Fund has increased in size steadily since its inception 10 years ago. In 2004/5 it increased by $1.5 million and a further increase of $3.88 million has been announced for 2005/6.

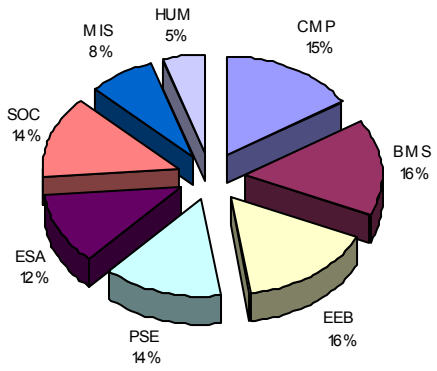
Each year, approximately one third of the total budget becomes available for new projects from expired projects and new money allocated to the Fund. In 2004/5, funding of $33.2 million over the next three years was awarded to new contracts. This was less than the previous year; however 2003/4 was unusual because there was a special release of money to reduce the level of funds held. This led to high forward commitments on the Fund to be absorbed over the following 3 years. The amount available for distribution from the 2005 funding round onwards will return to more normal levels. It has been boosted by the Vote being increased to $38.169 million per year. Figure 14 shows the trend in allocation amounts and Government funding in recent years.

Figure 14. Funds allocated to new Marsden Fund projects



The distribution by research area of the $33.2 million funding to contracts commencing in the 2004/5 year, is shown in Figure 15. Note that the proportion of the Fund to allocate to each area of research is not predetermined, but is a consequence of the numbers of proposals received and their excellence relative to proposals not selected.

Figure 15. Funding by research area for new contracts in 2004/5



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;

For these new research contracts, 47 % of the funding is for the medical and life sciences, 34 % for the physical sciences, earth sciences and mathematics, 14 % for the social sciences and 5 % for the humanities. The discipline spread is similar to previous years, except for the Social Sciences which has increased from 9 % to 14 % of the total in the last 4 years.

APPENDIX 2. EXAMPLES OF PRESTIGIOUS PAPERS FROM MARSDEN WORK

Penny D. (2004) Evolutionary biology: our relative genetics. *Nature* 2004 427(6971):208–9

Steinberger B, Sutherland R, and O'Connell RJ (2004) Prediction of Emperor-Hawaii seamount locations from a revised model of global plate motion and mantle flow. *Nature* 2004 430(6996):167–73

Mora CV, Davison M, Wild JM, and Walker MM (2004) Magnetoreception and its trigeminal mediation in the homing pigeon. *Nature* 2004 432(7016):508–11

Knapp M, Stöckler K, Havell D, Delsuc F, Sebastiani F, and Lockhart PJ. (2005) Relaxed Molecular Clock Provides Evidence for Long-Distance Dispersal of Nothofagus (Southern Beech). *PLoS Biol* 3(1): e14

Sneyd J, Tsaneva-Atanasova K, Yule DI, Thompson JL, and Shuttleworth TJ (2004) Control of calcium oscillations by membrane fluxes. *PNAS* 101(5):1392–6

Wardle DA, Bardgett RD, Klironomos JN, Setala H, van der Putten WH, Wall DH (2004) Ecological linkages between aboveground and belowground biota. *Science* 304(5677):1629–33

Abe F, Bennett DP, Bond IA, Eguchi S, Furuta Y, Hearnshaw JB, Kamiya K, Kilmartin PM, Kurata Y, Masuda K, Matsubara Y, Muraki Y, Noda S, Okajima K, Rakich A, Rattenbury NJ, Sako T, Sekiguchi T, Sullivan DJ, Sumi T, Tristram PJ, Yanagisawa T, Yock PCM, Gal-Yam A, Lipkin Y, Maoz D, Ofek EO, Udalski A, Szewczyk O, Zebrun K, Soszynski I, Szymanski MK, Kubiak M, Pietrzynski G, Wyrzykowski L (2004) Search for Low-Mass Exoplanets by Gravitational Microlensing at High Magnification. *Science* 305(5688):1264–6

Gerst A, and Savage MK (2004) Seismic anisotropy beneath Ruapehu Volcano: A possible eruption forecasting tool. *Science* 306(5701):1543–7

Jickells TD, An ZS Andersen KK, Baker AR, Bergametti G, Brooks N, Cao JJ, Boyd PW, Duce RA, Hunter KA, Kawahata H, Kubilay N, La Roche J, Liss PS, Mahowald N, Prospero JM, Ridgwell AJ, Tegen I, and Torres R (2005) Global Iron Connections - Desert Dust, Ocean Biogeochemistry and Climate. *Science In Press*

APPENDIX 3. MARSDEN FUND - BUILDING HUMAN CAPACITY

PRINCIPAL AND ASSOCIATE INVESTIGATORS

The Marsden Fund has supported established researchers by:

- Funding contracts starting in the 2004/5 year that involve 103 principal investigators (all except eight of whom are based in New Zealand) and 98 associate investigators (of whom 67 % are based in New Zealand).
- Supporting contracts in the current year which involve 823 separate individuals as principal and/or associate investigators.

NEW AND EMERGING RESEARCHERS

The Marsden Fund invests heavily in emerging researchers. 25 Fast-Start contracts were awarded in 2004/5 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 which is administered by FRST. For the 658 contracts awarded between 1996 and 2004, funding has been available for postdocs in 38 % of them, providing the equivalent of 229 full-time 3-year appointments. In the 2004/5 year, the first year of new contracts has supported 20.5 FTE in postdoctoral positions.

For the 728 contracts awarded between 1996 and 2004, funding has been available for postgraduate students in 55 % of them. In the 2004/5 funding round, the first year of new contracts has supported 40.8 FTE in postgraduate positions.

In 2004/5, 48 % of all principal investigators and 35 % 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). The participation of emerging researchers is significantly greater than would be expected from demographic considerations alone (Figure 16 and Figure 17). Four years ago, before the start of the Fast-Start scheme, 27 % of all principal investigators were within 10 years of completing their Ph.D.

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"[8]. [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.

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

Figure 16. Experience of principal investigators (PIs) on contracts awarded from 2000–04, as measured by the number of years since the principal investigator obtained their highest degree.

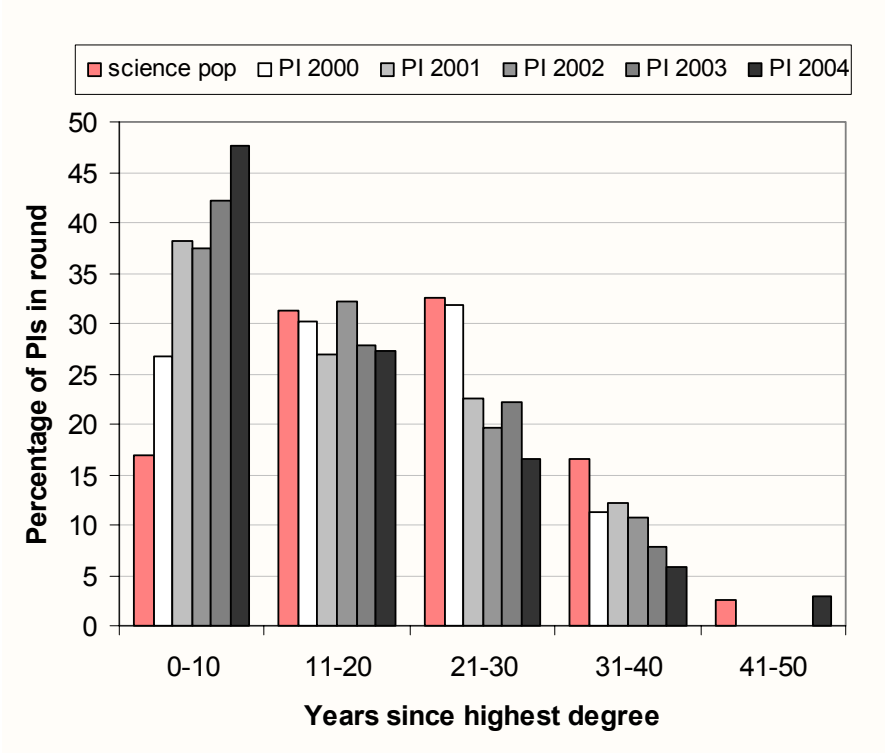
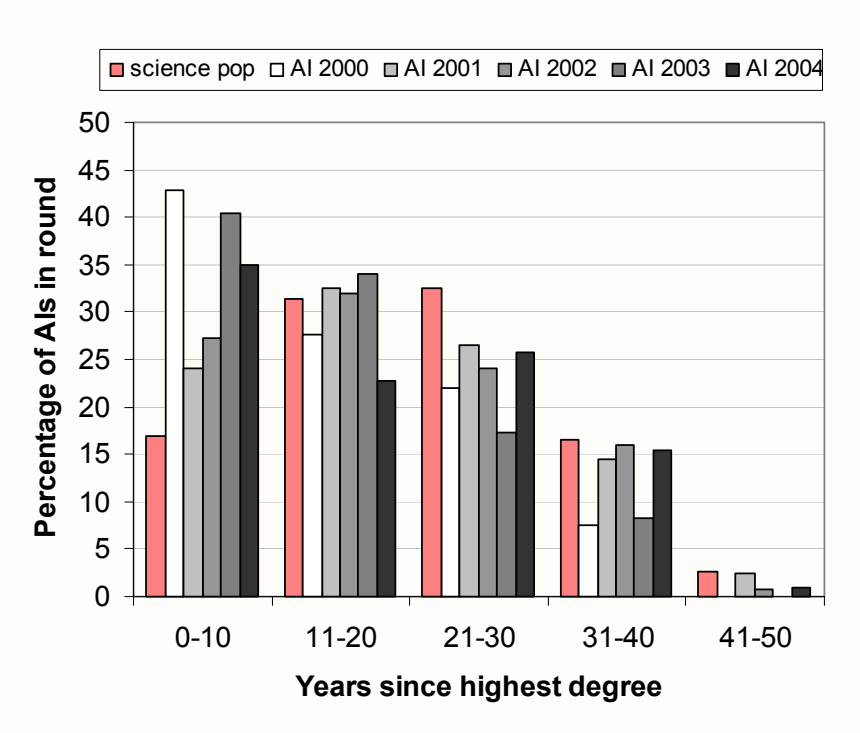


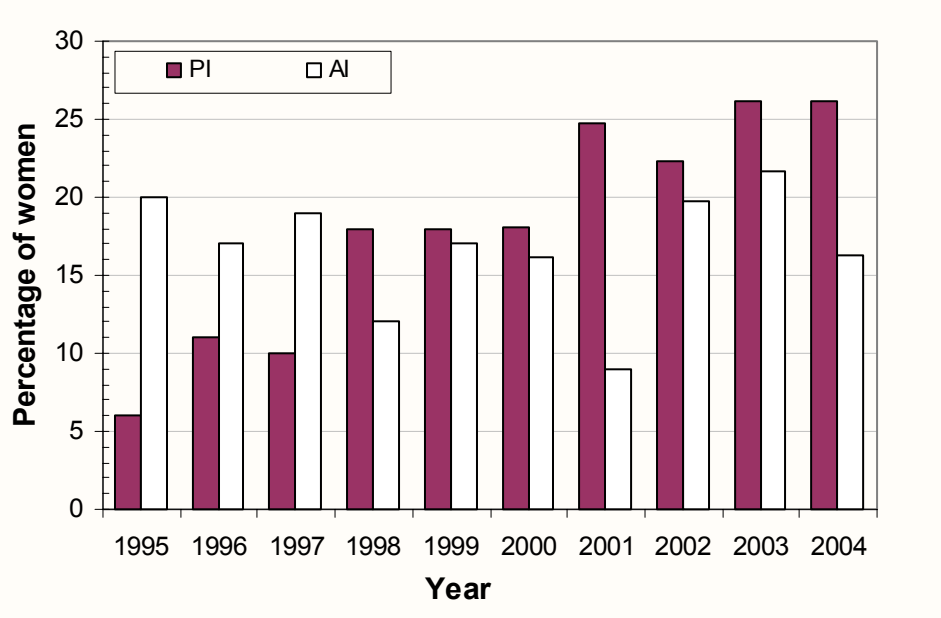
Figure 17. Experience of associate investigators (AIs) on contracts awarded from 2000–04, as measured by the number of years since the associate investigator obtained their highest degree.



WOMEN RESEARCHERS

In 2004/5, 26 % of the principal investigators on successful applications are women. For science projects (i.e. excluding the humanities), the figure is 22 %[9].

Figure 18. Percentage of principal, (PI) and associate (AI), investigators who are women.



MĀORI RESEARCHERS

For contracts active in the 2004/5 year, the percentage of principal and associate investigators who are Māori is 4.1 %, although Māori researchers contribute to 9.9 % of the contracts. In the 1997 Royal Society survey (referred to above), 0.7 % of scientists identified themselves as Māori.

[9] 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.

SUMMARY-PEOPLE SUPPORTED IN MARSDEN CONTRACTS

Table 9. Participation in Marsden grants.

	1999/0	2000/1	2001/2	2002/3	2003/4	2004/5
Investigators - Number of separate individuals acting as principal[10] and/or associate[11] investigators on current contracts	660	729	769	791	923	896
Emerging researchers – Percentage of PIs on contracts awarded in the funding round who have received their highest degree within the last 10 years	26 %	27 %	38 %	38 %	43 %	48 %
Postdoctoral[12] fellows – Percentage of standard contracts in the year's funding round which involve postdoctoral fellows	47 %	44 %	47 %	47 %	48 %	46 %
Students – Percentage of contracts in the year's funding round which involve postgraduate[13] students	47 %	70 %	49 %	57 %	59 %	65 %
Women – Percentage of female PIs on contracts awarded in the funding round	18 %	18 %	25 %	22 %	26 %	26 %
Māori – Percentage of Māori PIs and AIs on contracts awarded in the funding round	1.6 %	0.9 %	4.0 %	1.3 %	5.6 %	4.1 %

[10] 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

[11] AIs – Associate Investigators – researchers who play a lesser role than principal investigators and sometimes are involved with onlylimited aspects of the work.

[12] 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.

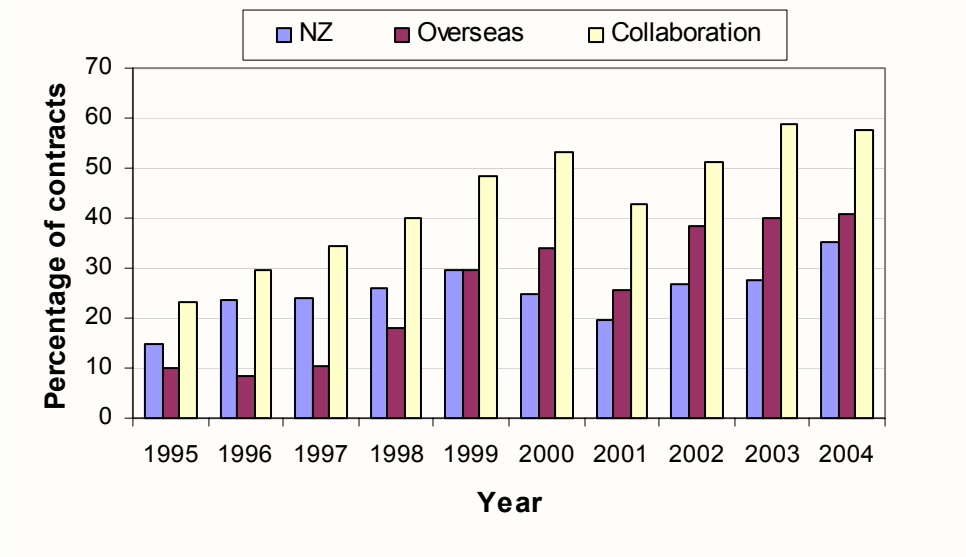
[13] Postgraduate students – researchers who are working on a Masters of Ph.D. thesis.

APPENDIX 4. MARSDEN FUND - 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 42 % in 2004.

The percentage of contracts that specifically include overseas principal or associate investigators at their onset is 41 % for the 2004/5 funding round. Further collaboration occurs during the course of the research. For projects completed in the 2004/5 year, 29 % included overseas researchers at their inception; by the time they had finished, 84 % had international collaborators. Since 1996, the percentage of contracts with a New Zealand collaborator from outside the host institution has typically been steady at 20-30 %, however the 2004/5 round saw 35 % of contracts involving investigators from two or more NZ institutions (see Figure 19).

Figure 19. 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 either type of collaboration is also shown. The year refers to the starting date of the contract.



BENEFITS TO NEW ZEALAND RESEARCH FROM MARSDEN-FUNDED INTERNATIONAL COLLABORATION

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

- Transgenic mice with labelled neurones, required for research into hearing, are being generated in the USA.
- Superconducting samples made in New Zealand have been examined using advanced physics instruments in Europe (muon spin resonance and high-pressure inelastic neutron scattering).

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

- A postdoctoral fellow has completed three training courses in statistical design, database use and analysis of microarray data, and is attending another course on bioinformatics and statistics at NIH in the United States.
- Another postdoctoral fellow spent a month in the USA laboratory of a collaborator, learning new synthetic chemistry techniques.

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

- A PI held a large international conference at Canterbury on security in the Pacific. This was attended by a wide range of people from diverse areas including government.
- A PI investigating war atrocities co-organised a symposium at the 22nd International Congress of History of Science held in Beijing, which gathered together leading figures in his field.
- A PI has hosted a German research fellow on sabbatical for a year to work on endophytes in rye grasses. He has also hosted a Japanese postdoctoral fellow who was originally funded by a Japanese postdoctoral scheme and has continued to work in New Zealand.

Hosting young researchers and students from overseas to build links for the future. Examples include:

- A PI hosted a student from the University of Munster for 2 months to learn organic synthesis methods.
- Two Masters students from Germany and one from Canada visited New Zealand to work on a New Zealand superconductivity programme.

Leveraging Marsden funding with overseas funding. Examples include:

- One PI's salary was supported for 5 months by a university in the USA, while he worked with a collaborator there.
- Three social science researchers studying the effects of European exploration of the Pacific have built upon their Marsden activities with additional funding from bodies in the United Kingdom, USA, and France.

Table 10. International collaboration and communication on Marsden grants.

International collaboration and communication	1999/0	2000/1	2001/2	2002/3	2003/4	2004/5
International collaboration – successful proposals in the year's funding round with PIs and/or AIs from overseas	30 %	34 %	26 %	38 %	40 %	41 %
International collaboration – current contracts with international collaboration (excepting proposals funded in the year's round)	73 %	67 %	67 %	65 %	66 %	discontinued
International collaboration – contracts completed in the year with PIs and/or AIs from overseas						29 %
International collaboration – contracts completed in the year with international collaboration						84 %
International Presentations – current contracts (excluding those awarded in the year's funding round) which were presented at international conferences	67 %	63 %	65 %	72 %	78 %	69 %

APPENDIX 5. MARSDEN FUND - BUILDING NEW ZEALAND'S KNOWLEDGE BASE

RESEARCH PRODUCTIVITY AND DISSEMINATION

Table 11. Publications, patents and software directly attributed to Marsden grants.*

Year of Publication	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	All Years
Papers	24	37	97	135	255	304	391	426	422	410	2501
Refereed Conference Proceedings		2	15	27	34	43	77	85	102	74	459
Book Chapters	3	2	6	11	25	27	42	53	65	65	299
Books			1	1	2	2	3	10	10	13	42
Edited Volumes					2	3	2	9	11	5	32
Reports		1	5	14	13	22	12	15	8	17	107
Patents (Full or pending)					1	1	1	2	2	3	10
Software					1				3	1	5
Total	27	42	124	188	333	402	528	600	623	588	3455

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

Table 12. Dissemination of Marsden results through conferences and other channels‡.

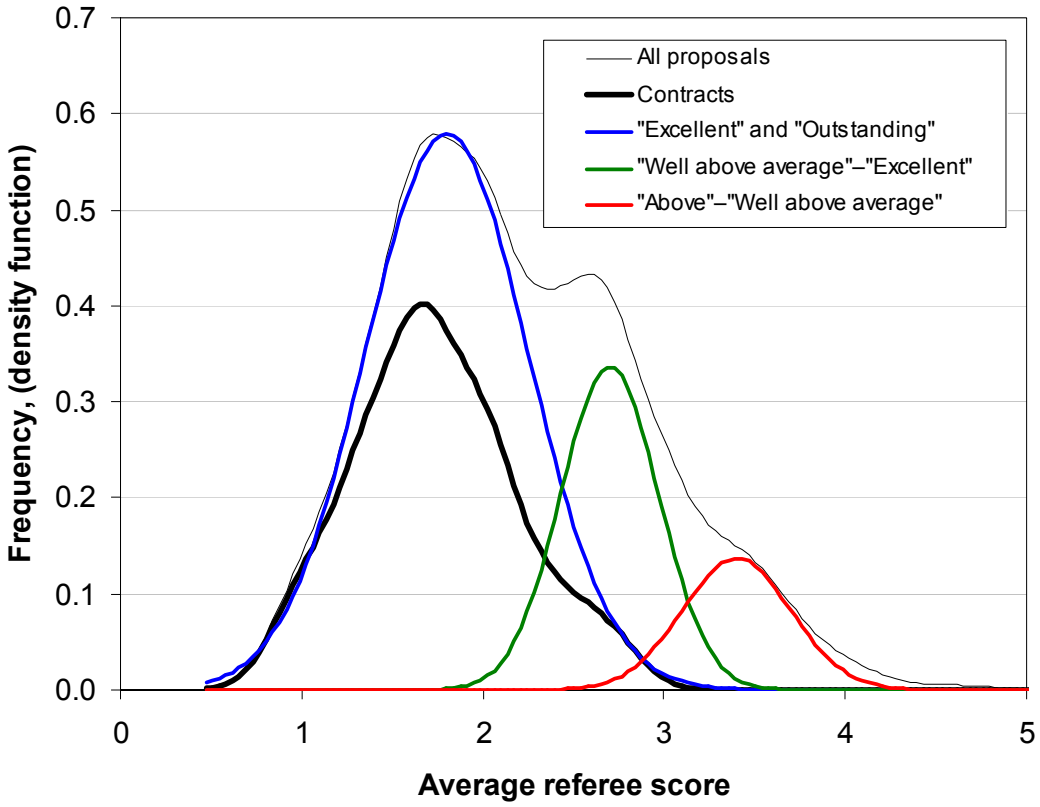
Year of Activity	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	All Years
Invited conference talk		1	15	36	44	63	92	106	115	161	633
Contributed conference talk		2	24	71	128	249	314	409	285	309	1791
Conference poster	9	8	47	116	170	155	98	87	87	111	888
Other†				6	10	11	26	35	34	60	182
Total	9	11	86	229	352	478	530	637	521	641	3494

†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 previous years continues to be collected.

RESEARCH QUALITY

The quality of Marsden-funded research is ensured by rigorous selection procedures, including national and international peer review of all proposals that proceed to the second stage of the evaluation process.

Figure 20. The distribution of referee scores for both funded and unfunded proposals to the 2003–2005 funding rounds. Scores equate to: 1 = "Outstanding – among the top 5 % of proposals worldwide"; 2 = "Excellent – among the top 10 % of proposals worldwide"; 3 = "well above average, top 20 %"; 4 = "above average"; and 5 = "average or below average".



Analysis of the distribution of average referee scores suggests that there are three distinct groups of full proposals: the majority (~65 %), which referees rated as being "Excellent" to "Outstanding"; and two smaller populations with average scores from "Well above average"–"Excellent" (~24 %), and "Above average"–"Well above average" (~11 %).

As the success rate at the second stage during these rounds was 44 %, this indicates that there were another ~21 % of full proposals which were judged as being internationally excellent, or better, but could not be funded (see Figure 20). To fund all of the "Well above average", i.e. within the top 20 % worldwide, proposals (solid, hatched, and stippled areas)would require lifting the overall success rate to ~20 %, while to be confident that 90 % of the "Excellent"–"Outstanding" proposals were supported would require a success rate of 14 %. Based on the 2005/6 round, this would suggest a Fund of approximately $85M, or $60M, respectively

Measures of research excellence for contracts current in the 2004-05 year are as follows:

- Papers on current Marsden contracts have been published in prestigious journals with high impact factors such as Nature and Nature Neuroscience, Science, Proceedings of National Academy of Sciences, PLoS-Biology, EMBO Journal, Physical Review Letters, Journal of Neuroscience, Applied Physics Letters, Journal of Bacteriology, American Journal of Physiology, Journal of Molecular Evolution, and the Journal of Biological Chemistry.
- The results from 79 % of current contracts (excluding those awarded in 2004/5) have been presented at international conferences.
- Of the 7 holders of the prestigious James Cook Research Fellowships with tenure in the 2004/5 year, 4 are principal investigators on current Marsden contracts.
- Numerous prizes and awards to Marsden researchers, as listed in Table 13.

Table 13. Awards and prizes- for 2004/5 contracts

Marsden researcher	Contract(s)	Distinction awarded
Professor Paul Callaghan	PI, VUW310	Ampère Prize
Professor Paul Callaghan	PI, VUW310	The Dominion Post Wellingtonian of the Year, Science category
Dr Thomas Proft	PI, UOA103	Invitrogen Queenstown Molecular Biology award 2004
Professor David Penny	PI on 8 contracts	Rutherford Medal
Dr Bob Buckley	AI, IRL202	Pickering Medal
Dr Greg Cook	PI, UOO003 and UOO313	Early Career Award for Distinction in Research (University of Otago)
Dr Craig Rodger	PI, UOO214	Early Career Award for Distinction in Research (University of Otago)
Professor Peter Barrett	GNS102, GNS0401	2004 Marsden Medal (NZ Association of Scientists)
Dr Nic Smith	AI, UOA320	Awarded the Auckland University Vice-Chancellors' award for research.
Prof David Officer	PI, MAU012	HortResearch Prize for Chemical Excellence
Dr Ralph Bungard	PI, UOC002	"Outstanding Physiologist" (New Zealand Society of Plant Physiologists)
Associate Professor Iain Lamont	PI on 2, AI on 2	Applied Biosystems Award (New Zealand Society for Biochemistry and Molecular Biology)
Associate Professor Eamonn O'Brien	PI on 2, AI on 1	NZMS Research Award (New Zealand Mathematical Society)
Professor Cam Nelson	PI, UOW523 and UOW801	Hutton Medal (RSNZ)
Professor John Fraser	AI, UOO306	Elected Fellow of the Royal Society of New Zealand
Professor Boris Pavlov	PI, UOA612	Elected Fellow of the Royal Society of New Zealand
Professor Leslie Oxley	PI on 3, AI on 1	Elected Fellow of the Royal Society of New Zealand
Professor Graeme Wake	PI, UOA515	Elected Fellow of the Royal Society of New Zealand
Professor Stephen Wratten	PI, LIN401	Elected Fellow of the Royal Society of New Zealand
Professor Helen Leach	PI, LCR001 and UOO0408	Elected Fellow of the Royal Society of New Zealand
Professor Marston Conder	PI on 4, AI on 4	Hood Fellowship
Dr Phil Shane	AI, AUL101	Awarded the McKay Hammer (for the most meritorious Earth Science publications in the preceding three years)
Associate Professor Jamie Shulmeister	PI, UOC301	2005 Hochstetter Lecturer for the Geological Society of NZ
Professor Dick Bellamy	PI on 2, AI on 1	CNZM (Companion of the NZ Order of Merit)
Professor Wystan Curnow	AI, UOA705	CNZM (Companion of the NZ Order of Merit)
Professor Kathryn Crosier	PI, UOA209	ONZM (Officer of the NZ Order of Merit)
Professor Roger Horrocks	PI, UOA823	MNZM (Member of the NZ Order of Merit)
Dr John Reynolds	PI on 1, AI on 2	Brain Research Young Investigator Award (conferred by the editors of the neuroscience journal Brain Research and scientific publishing house Elsevier Science on three young scientists each year).
Professor Geoffrey Jameson	PI on 4, AI on 2	2004 SGS Prize for Excellence in the Chemical Sciences (NZ Institute of Chemistry)

Dr Sue McCoard	**AGR303**	**Named emerging biotechnologist of the year at the inaugural NZ Bio Conference in Auckland, March 2005**
Professor Robert Biddle & Professor James Noble	**VUW309**	**IBM Eclipse Research Innovation Awards for 2004 and 2005**
Professor James Noble	**VUW309**	**Neil B. Harrison Award for Shepherding (best reviewer) at European Conference on Pattern Languages of Program Design**

APPENDIX 6. MARSDEN FUND CONTRIBUTION TO ISSUES OF PUBLIC INTEREST

Table 14. Marsden Fund Contribution to Issues of Public Interest

Issue	No. of projects	Funding ($ million)	Description
Genetics	126 (incl. 37 for use as a tool)	14.7 (incl. 5.1 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	62	6.0	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	78	8.5	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	11	1.1	Archaeology, language, settlement, museum practise, rangatiratanga, and Ta Moko.
Children and adolescents	7	0.97	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	13	1.2	Plate tectonics, volcanic and seismic activity.
Climate change	21	2.2	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	14	0.75	Computer architecture, software, data transmission, virtual reality, machine learning, numerical computation and the theory of computation.
New materials and nanotechnology	29 (incl. 7 in nanotech)	2.9 (incl. 0.52 in nanotech)	Investigating new materials, including developing materials and material processes for nanotechnology.
Developmental biology	25	2.5	Investigating various aspects of plant and animal development (e.g. muscle development, the control of flowering), as well as various aspects of learning and memory development.

APPENDIX 7. AREAS OF STRENGTH AND UNDER-REPRESENTATION IN MARSDEN-FUNDED RESEARCH

Table 15. Areas of strength in Marsden-funded research

Panel	Strengths
Biomedical Sciences BMS)	Neuroscience, electrophysiology, molecular and cell biology of programmed cell death, structural biology.
Cellular, Molecular and Physiological Biology (CMP)	Plant developmental biology and physiology, microbial genetics and physiology, structural biology, signal transduction
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 and inorganic synthetic chemistry continues to be well developed, with potential biological and materials applications. There is particular strength in superconductivity, soft condensed matter physics, quantum physics, and extreme low temperature physics (Bose-Einstein condensation). A number of projects span traditional disciplinary boundaries, in bioengineering and biophysics.
Earth Sciences and Astronomy (ESA)	Strong areas are climate related research, especially climate processes and palaeoclimatology, ice physics, astronomy, tectonics and crustal geophysics, 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, group theory, software engineering, 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.

Table 16. Areas under-represented in Marsden Fund-funded research

Panel	Under-represented areas
Biomedical Sciences (BMS)	Microbiology, genetics, bioinformatics.
Cellular, Molecular and Physiological Biology (CMP)	Basic biochemistry, quantitative genetics, electrophysiology, bioinformatics, animal developmental biology.
Ecology, Evolution and Behaviour (EEB)	Physiology, biological oceanography.
Mathematical and Information Sciences (MIS)	There is concern that limited funding is restricting the success rates in certain areas of applied mathematics
Physical Sciences and Engineering (PSE)	Polymer chemistry, analytical chemistry, and catalysis are under-represented. There are very few mainstream engineering projects.
Earth Sciences and Astronomy (ESA)	Soil science, coastal processes and oceanography, engineering geology, and structural geology.
Social Sciences (SOC)	Sociology, geography, and business/management.

APPENDIX 8. JAMES COOK RESEARCH FELLOWSHIPS

During 2004/5 there were eight active Fellowships:

- Dr Michael Berridge (Health Sciences): Cell surface respiration in health and disease—completion date 03/2005;
- Professor Charles Higham (Social sciences): The origins of the civilisation of Angkor—completion date 04/2005;
- 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;
- Professor Margaret Brimble (Physical Sciences): Synthesis of shellfish toxins as novel chemotherapeutic agents—completion date 06/2006;
- Associate Professor Andrew Pullan (Engineering Sciences and Technologies): Detailed computer modelling of gastro-intestinal bioelectric activity—one year extension granted—completion date 06/2006;
- Professor Colleen Ward (Social Sciences): Acculturation, adaptation and intercultural relations—completion date 03/2007;
- Professor Robert Jackson (Biological Sciences): Predators that target human disease vectors—completion date 03/2007.

AGE AND DISCIPLINE

Of the 29 Fellowships awarded since 1996, the average age on starting the Fellowship is 51 years, spanning the range 38 to 67 years with half in the 40 to 50 age category. Three of the Fellows have been women. In total the discipline split has been as follows:

6 in Biological Sciences;
3 in Engineering;
5 in Health sciences;
5 in Physical sciences;
4 in Research of relevance to New Zealand and/or South West Pacific;
6 in Social Sciences.

COLLABORATION

Collectively more than 12 international collaborations were set up with researchers in Australia, United Kingdom, United States, France and Hawaii. At least eight collaborations within New Zealand were set up

TRAINING

Two of the Fellows interacted with and trained young researchers as part of their Fellowship work. As a result the young researchers were exposed to new skills and honed existing skills.

APPENDIX 9. TEACHER FELLOWS

SCOPE AND SCALE

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 practice in industries, carrying out their own research project, to taking the opportunity to spend time with a number of different enterprises to learn about the science and technology underpinning their activities.

Table 17. The number of Teacher Fellowships awarded has increased since 1994:

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Number	17	19	19	15	16	18	39	40	48	58	59	59	64
Applications	*	*	*	30	33	53	52	98	111	120	105	109	121

* Not recorded

NB: 2 Fellowships awarded were not taken up because the awardees took new teaching positions prior to their Fellowship year, one in 2001, and one in 2003.

We received 121 applications for 2006 with 57 from women, 39 from primary school teachers, 8 from composite school teachers, and 75 from secondary school teacher.

Table 18. 2005 decile distribution

Decile	1	2	3	4	5	6	7	8	9	10	Private
	6.5%	3.1%	3.1%	7.8%	10.9%	9.4%	9.4%	15.6%	10.9%	18.8%	4.7%
2005	6.8%	0.0%	6.8%	8.5%	8.5%	13.6%	13.6%	15.3%	5.1%	20.3%	1.7%
2004	5.2%	5.2%	10.3%	6.9%	8.6%	6.9%	10.3%	8.6%	12.1%	24.1%	1.7%
2003	1.8%	5.4%	8.9%	7.1%	8.9%	16.1%	10.7%	10.7%	14.3%	10.7%	5.4%
2002	4.4%	2.2%	4.4%	8.7%	8.7%	0.0%	21.7%	13.0%	17.4%	15.2%	4.4%
2001	5.0%	10.0%	7.5%	10.0%	5.0%	2.5%	7.5%	10.0%	20.0%	20.0%	2.5%
2000	7.7%	12.8%	2.6%	7.7%	2.6%	12.8%	18.0%	5.1%	18.0%	10.3%	2.6%

While there are marked year to year variations in the distribution of Teacher Fellowships to schools of different decile ratings, there is no obvious trend. There has been a slight increase over the past 6 years in awards to teachers from schools of decile 4 and lower, but we still have much work to do to reach equity of awards related to decile rating of schools.

Table 19. 1994 – 2005 Gender distribution

Year	94	95	96	97	98	99	00	01	02	03	04	05	06
Female	35%	26%	53%	33%	63%	44%	50%	55%	46%	50%	53%	64%	53%

Again, while there may be annual variation, awards now more closely reflect gender distribution within the teaching sector.

Table 20. 2002 – 2005 Ethnic distribution

Year	2002	2003	2004	2005	2006
European	43	53	52	55	61
Māori					1
Māori /European	3	1		1	
Pasifika					
Other	2	1	4	3	2

These figures clearly demonstrate the difficulty we have in engaging non-European teachers in Teacher Fellowships. There are good reasons for this which we have elaborated upon in previous Progress and Achievement Reports, notably the scarcity of relief teachers suitable to replace teachers in Māori medium immersion classes and Kura kaupapa, but we feel that more could be done to encourage and support Māori and Pasifika teachers, especially those in lower decile schools, to formulate proposals. Unfortunately we do not have the capacity to carry this out.

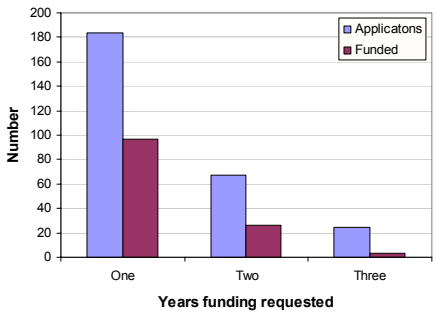
APPENDIX 10. ISAT LINKAGES FUND DATA

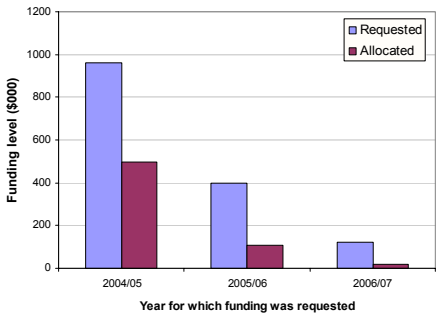
SCOPE AND SCALE

For the year to 30 June 2005, 185 applications were received for the bilateral programme with 89 (48 %) seeking out-year funding. 97 (52 %) applications (with a value of $429,174) were successful in receiving funding for 2005-06, 26 applications received funding for 2006-07 ($106,220) and 2 ($14,500) for 2007-08.

Figure 21 shows the number of applications received and funded for 2004-05 and the funding sought and the value of those funded.

Figure 21. Distribution of awards and funding level for the 2004/5 ISAT round





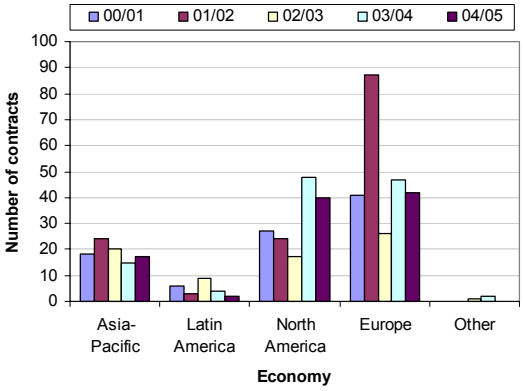
APPLICATIONS AND SUCCESS RATES

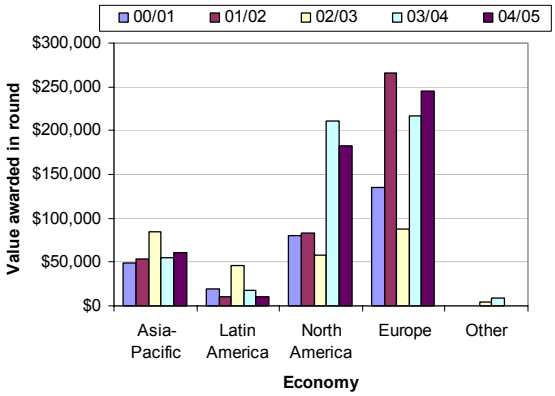
Applications to the Fund are called for twice yearly with a selection panel of six eminent researchers evaluating the applications and recommending those for funding.

In the year to 30 June 2005, the Society received 185 applications from New Zealand researchers wishing to collaborate with international researchers through the Fund. 97 (52 %) applications were successful in obtaining funds with 26 (27 %) of the applicants receiving funding for more than 1 year. The average size of a grant is $4.4k.

The following two graphs distinguish the trends over the past 5 years noting that the Fund was significantly increased in 2003-04:

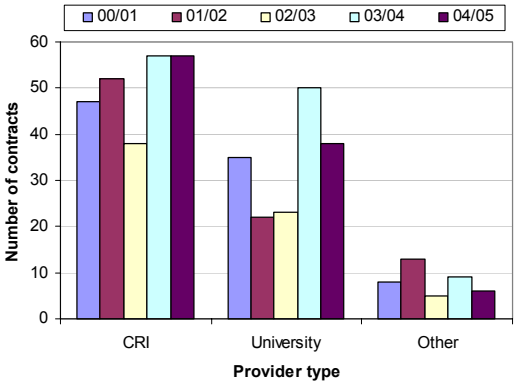
Figure 22. Distribution of awards and funding level by collaborating economy

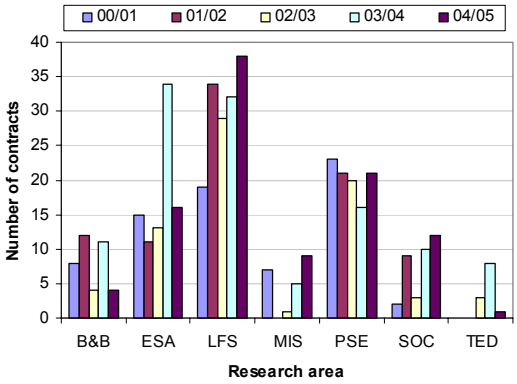




The following two graphs show the number of contracts awarded over the last five years by institution and by research area.

Distribution of awards by contracting institution and research area





B&B (biochemical and biomedical), ESA (earth sciences and astronomy), LFS (life sciences), MIS (mathematical and information science), PSE (physical science/engineering), SOC (social sciences), TED (technology development).

APPENDIX 11. DESTINATIONS FOR TRAVEL SUPPORT AWARDEES

Events offered by the Royal Society and attended by New Zealand students for 2004/5 were:

- London Youth International Science Forum, England (fully sponsored by BRANZ and British Countil NZ)

Events offered by the Royal Society to students who were also assisted by Talented School Students Travel Award"

- USA International Space Camp, Alabama, USA
- Biofutures, Brisbane, Australia
- Australian International Space School
- Harry Messels International Science School, Sydney, Australia
- Beijing Youth Science Creation Competition, China

Other events assisted by Talented School Students Travel Award"

- The Hague International Model United Nations, The Netherlands
- International Future Problem Solvers Competition, USA
- Primary Asia Pacific Maths Competition, Singapore
- International Chemistry Olympiad, Taiwan
- International Biology Olympiad, Beijing, China
- International Maths Olympiad, Mexico
- International Software Competition, Chennai, India
- Fashion Design Workshop, Sydney, Australia
- International Conference Computers in Education

Teachers or other accredited adults accompanied the students to:

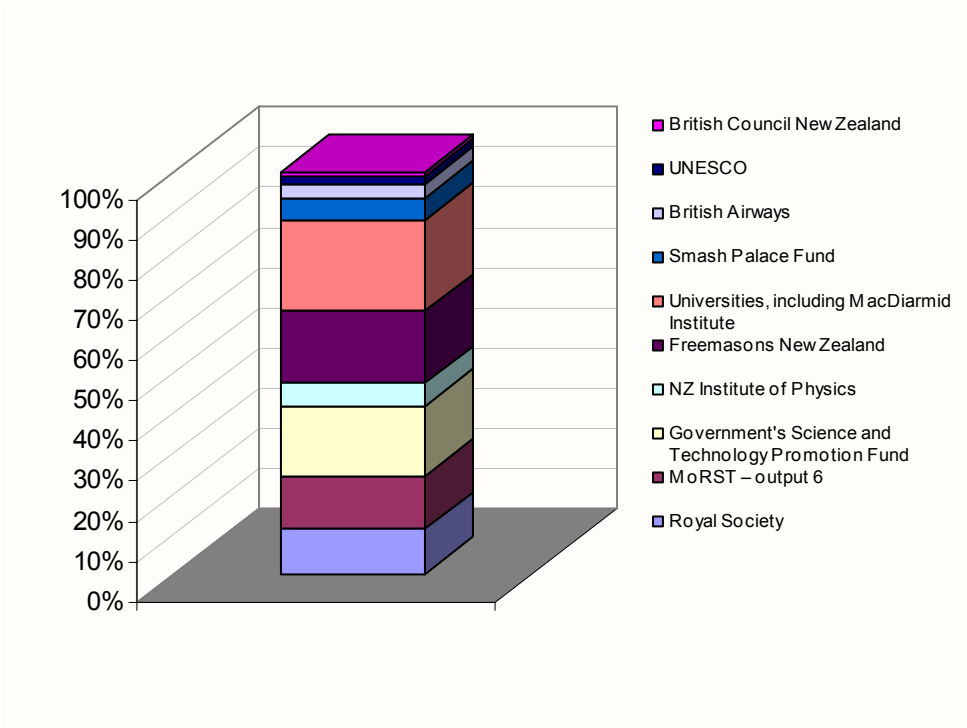
- International Future Problem Solvers Competition, USA
- Primary Asia Pacific Maths Competition, Singapore
- International Chemistry Olympiad, Taiwan
- International Biology Olympiad, Beijing, China
- International Maths Olympiad, Mexico
- USA International Space Camp, Alabama, USA
- Beijing Youth Science Creation Competition, China
- International Software Competition, Chennai, India

APPENDIX 12. FUNDING FOR YEAR OF PHYSICS

FUNDING FOR YEAR OF PHYSICS

- Universities, including MacDiarmid Institute
- Freemasons New Zealand
- Government science and technology promotion fund (for website)
- MoRST – output 6
- Royal Society
- NZ Institute of Physics
- Smash Palace Fund
- British Airways
- UNESCO
- British Council New Zealand

Figure 23. Relative contribution of funding sources to the Year of Physics



APPENDIX 13. SCIENCE AND TECHNOLOGY PROMOTION FUND ACTIVITIES

BOTTLED LIGHTNING

Organisation: ITP - Reefton Promotions

Project Leader: Paul Thomas

Awarded: $34,675.00

A visitor centre video based at Reefton's historical hydro site explaining electricity and why Reefton became the first town in New Zealand to have electricity.

Present status:
Script and graphics near finalisation. Filming started in mid June to complete by end August. First edit will be completed by end September. Planning for provision of screening in Reefton Visitor centre is underway.

DANCE OF MATHEMATICS

Project Leader: Dr William Baritompa

Awarded: $22,000

Through community dances and mathematical performances the patterns of mathematics are explained. Mathematics is portrayed as a fascinating subject done by 'real' people.

Present status:
5 highly successful events held in rural communities around Canterbury during April to June. Good media coverage

$E = mc^2$ WEBSITE

Organisation: e-net Limited

Project Leader: Gresham Bradley

Awarded: $92,000

Sophisticated website providing an interactive experience of physics topics through video-streamed interviews, stories, video conferences and interactive software. Designed to support the international Year of Physics.

Present status:
Website (www.eequalsmcsquared.co.nz) was launched on Wednesday 16 February 2005 with full subject content. In addition, featured on site are 12 winning videos and information relating to $E=mc^2$ Video Competition, video and diary entries from winning teams' trips to UK and Europe, links to audio streams for Radio New Zealand Royal Society Lecture series and the NASA Challenge videoconference. Visits to the website have averaged 10,833 over the last 4 months.

SCICARDS

Organisation: Otago Museum

Project Manager: Helen Horner

Awarded: $81,000

A trading card project designed to connect science and technology with pop culture by providing tradable and collectable cards linked to an interactive website.

Present status:
Launched on 29 April 2005 with first release of cards nationwide. Second release of cards was on 2 July 2005. Currently available from 90 distribution locations throughout New Zealand including Video Ezy stores, Toyworld stores, public libraries, science centres and museums. Over 60,000 SciCards were picked up from display stands throughout New Zealand in the first three months of the project. The Museum also houses the IBM SciCards Lab which is the national hub of the SciCards and has attracted television and media attention. The website is an integral part of the project and is at www.scicards.co.nz

SCI-QUEST

Organisation: Waikato Museum

Project Leader: Kate Vusoniwailala

Awarded: $13,000

Sci-Quest is a touring exhibition about having fun with waves and motion areas of physics. The exhibition was produced for Waikato Museum and funding was made available to tour this exhibition nationally.

Present status:
Exhibition showing at MOTAT and going to Te Manawa Museum (Palmerston North) in two months time.

OUCH! STINGERS, SUCKERS AND BITERS

Organisation: Auckland Museum Institute

Project Leader: Margaret Spencer

Awarded: $18,000

To provide interactive models for exhibition and attract and assist people who would not normally be involved to participate in a high quality science exhibition presented at Auckland Museum.

Present status:
This project has now successful completed. Four interactive models were made for the OUCH Exhibition at Auckland Museum which opened in December 2004. In addition links with the Community School holiday programme in south Auckland enabled 12 groups to attend and provided transport and free entry to the exhibition.

WORLD OF WATER

Organisation: Partners Porirua Charitable Trust

Project Leader: Michelle Robinson

Awarded: $28,000

A partnership initiative that aims to use water as a theme to excite, motivate and inspire young people in the way they think about science.

Present status:
The focus of the first phase of this project has been to build links with industry and community partners. Projects have been planned for the 2005 school year with two schools (this will expand to five in 2006) including stream studies, water technology, cultural significance, water conservation and water and health.

UNDERSEA SOUNDSCAPE OF WELLINGTON HARBOUR

Organisation: National Institute of Water and Atmospheric Research

Project Leader: Stephane Popinet

Awarded: $43,000

Project to allow people to immerse themselves into the undersea sound environment while keeping their feet dry by installing hydrophones in Wellington harbour linked to a website and mobile interactive display booth.

Present status:
Hydrophones were put in place in January and currently in process of data acquisition and processing. Website currently under construction.

TUATARA: A TAONGA FOR THE PEOPLE OF NEW ZEALAND

Organisation: Victoria University of Wellington

Project Leader: Susan Keall

Awarded: $85,000

A project to bring science and technology to New Zealand school children via exciting presentations on the conservation of tuatara, using the latest research findings, multi-media techniques and live tuatara.

Present status:
Two iwi representatives have been trained both in the San Diego Zoo and Victoria University. Trial presentations were conducted at schools in Picton and Blenheim, New Plymouth and Whakatane. At each town centre, presentations are given to 10-12 primary schools, 2 high schools and a public event.

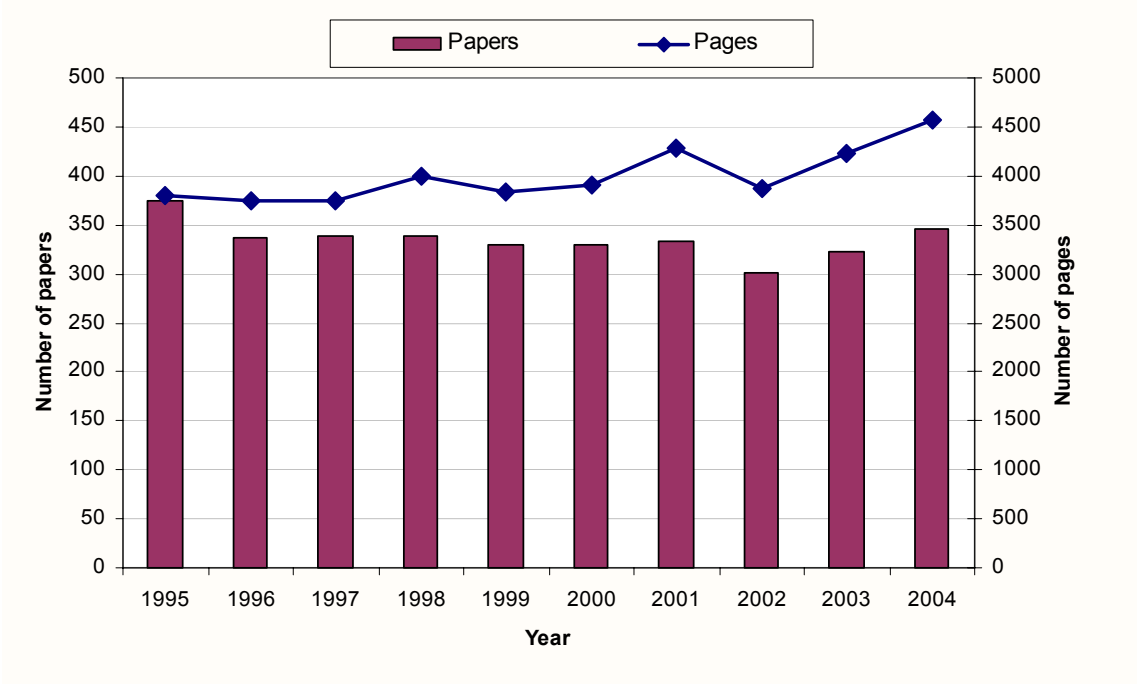
APPENDIX 14. PUBLICATIONS AND SUBMISSIONS

Table 21. Numbers of papers submitted and published in 2004

	NZJAR	NZJB	NZJCHS	NZJGG	NZJMFR	NZJZ	JRSNZ
No. of papers published	61	49	46	61	72	40	16
No. of submissions	104	52	113	46	160	45	23

The journals continue to publish a significant proportion of all New Zealand papers published. In 2004, 543 papers were submitted (the last 5 year average is 468), and 345 were published over 4572 pages (5 year averages 322 and 4175, respectively). More papers than average were submitted, and the size of papers published has slightly increased.

Figure 24. Publications and Submissions



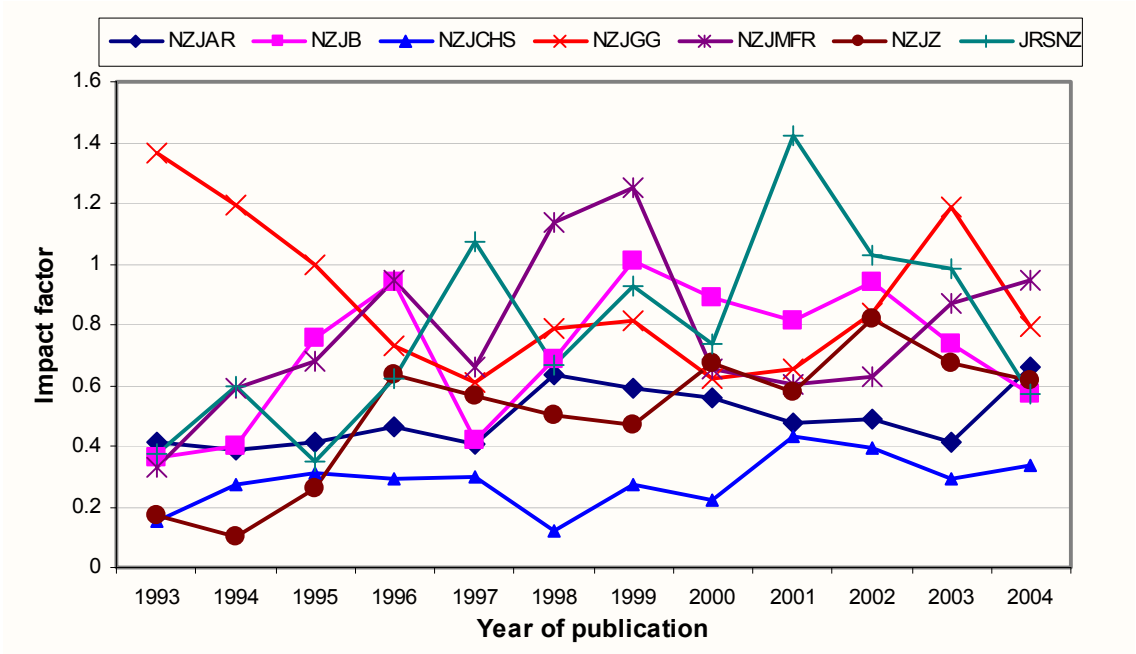
APPENDIX 15. JOURNAL IMPACT

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 than 10 years, which means that they remain relevant and useful publications for a long time following publication.

The ISI Citation Index figures for 2004 show that the Impact Factor for some of the journals has risen but that it has fallen for others. Overall movement, however, is slight, and the general trend over the last decade is upward.

The effects of the benefits of online access, such as increased citations, have yet to be realized. They require a 2 year measure to assess.

Figure 25. 2004 Impact factors for journals published by the Royal Society



APPENDIX 16. JOURNAL RANKING

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.

Journal ranking against other journals of similar disciplines also shows small variations, with three journals ranking in the top 40 % (JRSNZ multidisciplinary, NZJAR agriculture, NZJMFR fisheries; two in the top 60 % (NZJGG and NZJMFR); and the others between 60 and 80 %. These are commendable results considering the New Zealand journals are largely regional in scope and are ranked against other journals of more international content.

Figure 26. Relative ranking of the Royal Society journals for 2004/5