THE ROYAL SOCIETY OF NEW ZEALAND
PROGRESS & ACHIEVEMENTS REPORT

October 2002

CONTENTS

EXECUTIVE SUMMARY

In this Progress and Achievement Report the Royal Society outlines an extensive array of achievements in the promotion of science and technology. The Royal Society welcomes the opportunity to report by output class, within which target outcomes and impact expectations are implicitly, rather than explicitly, considered. This has facilitated more coherence in the reporting.

The Royal Society's focus is on promoting excellence in science and technology, as laid down in our Act. We promote, invest in, and celebrate excellence in people and ideas in S&T and put them to work as an example and inspiration to New Zealanders. Many of our aims are shared with MoRST and the Government, where there is considerable synergy in our work.

We are very aware that the value of science and technology to the country comes when the providers of high quality scientific work are in contact with end users in a way that informs both parties. Each group has its own responsibilities, but each is enriched and challenged by understanding the other. The Royal Society is active in building closer links with industry, with the aim of encouraging each to think more widely – to see entrepreneurial possibilities where there were none and to develop channels for putting these to work. We will continue to work with the many groups we have ties with, both inside and outside of the Society. We will continue to generate ideas and bring them forward for discussion and action.

This report identifies a number of key areas where new initiatives and funding issues need to be addressed by the Minister, MoRST and the Royal Society and these are listed in priority order. The Royal Society welcomes discussion on any of these points.

Marsden Fund

Research, Science & Technology are seriously under-resourced in New Zealand. It is generally accepted that New Zealand's future prosperity will come from the engine of science and technology, yet the Marsden Fund, which has grown considerably from small beginnings in 1995, and is hugely productive in terms of outcomes that are useful to New Zealand, is currently able to fund only 10% of applications, compared to a level of funding by international equivalents of 30 – 40%. To increase the effectiveness of this form of investment in New Zealand's future, the Marsden Fund Council (MFC) has a goal to increase the size of the Marsden Fund to $50m by 2005.

Publication of Science and Technology Journals

The dissemination of information is critical, both inside the scientific community and in the wider society, and New Zealand's scientific journals form a national strategic asset. However, resources for scientific journal publication have remained static over a decade while output has increased dramatically. In the last 10 years the journals have not received any increase, with no allowance for the 33% inflation over that period. During that time, journal publishing worldwide has been experiencing a revolution in science publishing on the internet, which has been one of the main contributing factors leading to severe reductions in library subscriptions for the printed journal.

Science, Mathematics and Technology Teacher Fellowships

When the fund was increased in 2000, an amount of $4k per Teacher Fellow was accepted by the Ministry as the Society's marginal direct cost associated with each new Fellow. Thus we seek an additional $52k (including Society overheads)from 2003-04 to permit continuation of monitoring and evaluation at the current level.

Science and Technology Promotion Contestable Fund

The Science and Technology Promotion Contestable Fund returns outstanding value for money. Each year, up to 15 projects are awarded funding for a variety of imaginative projects that often have matching funding/resources. The impact of these projects is measurable and an expansion of the programme would be an excellent way of investing in science and technology promotion in New Zealand. It is a way of ensuring a good spread of activity throughout the country. These are mostly projects that would not get off the ground otherwise. We strongly recommend that this fund be increased by at least 50% (ie. $200k). A lesser amount would elicit a cynical, rather than appreciative, response from potential applicants.

James Cook Research Fellowships

The James Cook Research Fellowships have proven highly effective in targeting researchers who are recognised leaders in their respective fields and the Society recommends that funding be increased in 2003-04 to a level that would allow awards of at least three fellowships per year, increased to a liveable stipend of $110k/year plus up to $10k/year expenses, plus at least one third year extension annually at this increased stipend level.

This would require an increase in overall funding of the scheme from $720k/year to $840k/year or $120k (Appendix VII refers).

Science and Technology Medals

At a recent meeting of the Royal Society Council, the President Sir Gil Simpson reported that he had met with Sir William Pickering who had agreed to the use of his name for a Royal Society medal rewarding excellence in technology. The Council agreed that this medal should have the status of the Rutherford Medal and it was suggested that the Pickering Medal could be added to the New Zealand Science and Technology suite of medals. Accordingly, the Rutherford Medal would now be awarded for excellence in science alone and the Pickering Medal awarded for excellence in Technology provided that government approve the initial cost of $8k to cover the cost of striking the medal and $5k annually to cover the costs relating to holding an award ceremony and the Society administration costs.

Summary

Fund levels

The Society recommends increases in the Contestable Science and Technology Promotion Fund from $400k to $600k; and James Cook Research Fellowships from $720k to $840k. Government has already signalled an increase in Marsden funding from $30.8m to $31.8m.

POLICY IMPLICATIONS AND FUTURE INVESTMENT PRIORITIES

Marsden Fund

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

i. Increasing the funding provided for administering the fund to provide for:
   - the recent and planned growth of the fund, and
   - the impact of the creation of the Marsden Fund Council and its role and activities compared with the previous Committee and the need for an executive to support the Council compared with the secretariat function at present.

ii. Increasing the fund to enable a greater proportion of the applications to succeed.

iii. Developing and increasing the fund in order to add to the types of awards made.

The importance of increasing the funding for the fund administration activities is described in Sections 4.2, 5 and 6. Essentially, a $30m fund is delivered by five people with some administrative support – several times more efficient than similar-sized funds in New Zealand. There has been no change in the delivery fee despite increases to the fund for three years. The Royal Society recommends an increase of the administrative fee to 4.9% of fund, for a total of $1.558m in 2003/04. If there is no adjustment, it will be necessary to reduce the monitoring and assessment and some promotion activities to compensate for the increases to the size of the fund already signalled for the next three years in order to provide a robust selection round each year and provide the minimum level of secretariat services to the Marsden Fund Council.

An increase in administration funding, however, would be targeted at:

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

Although the Marsden Fund is an elite funding instrument and is targeted at excellence, it has a very low success rate by international standards. The overall cost, both indirectly to the research community of preparing applications, and directly to the government of evaluating proposals, is high compared with the amount of research ultimately funded. The current success rate of 10.7% (for 2002/03) is well below that of the Australian Research Council who target 25% for their Discovery Fund. To increase the success rate of the Marsden Fund to 15% would require additional funding of $7.7m per year based on the current number and size of applications. To increase the effectiveness of this form of investment in New Zealand's future, the Marsden Fund Council have a goal to increase the size of the Marsden Fund to $50m by 2005. This involves a substantial increase to the fund from its present level of $30.8mfor 2002/03.

The Marsden Fund Council's strategy for the development of the fund includes introducing some longer-term awards, and developing new awards for particular segments of the research community such as mid-career researchers and expatriate New Zealand researchers wishing to return to the country. Some longer-term awards will be offered in 2003; however these will not have an impact on the size of the fund until 2007. The development and introduction of other new awards are planned from 2004 onwards. Detailed analysis and planning will be undertaken in 2003 providing there is sufficient operational funding available to the Royal Society, but there will not be an impact on the fund until the 2004/05 year.

James Cook Research Fellowships

As a result of issues raised under "Strategic direction" the Society recommends that fellowships be targeted to researchers who are recognised leaders in their respective fields rather than to "senior" scientists per se. This would require a change of wording in the Terms of Reference.

Within the funding currently available, i.e. $720k per year, the Society could offer more than 6 fellowships at the current salary of $90k per year (considered equivalent to an Associate Professor's

salary) plus a maximum of $10k expenses per Fellow per year (see Appendix VII). However, this level of funding is not considered adequate for a Fellow to carry out his research overseas. Also with more than 6 fellowships at any one time we would not be able to offer 3rd-year extensions and these are often requested and are considered to be very beneficial when the research has reached an exciting and productive stage.

A salary of at least a Professor's level ($110k) is considered necessary to allow a Fellow to carry out his or her research overseas but increasing salaries to this amount while maintaining at least 6 fellowships again allows for no 3rd-year extensions (see Appendix VII).

The Society therefore recommends that funding of the scheme be increased in 2003-04 to a level that would allow government to fund at least six fellowships per year, at an increased stipend of $110k/year plus up to $10k/year expenses, plus at least one 3rd-year extension annually at this increased stipend level. This would require an increase in overall funding of the scheme from $720k/year to $840k/year (Appendix VII).

Science, Mathematics and Technology Teacher Fellowships

The Society has taken a more active role in the management of individual fellowships and their ongoing activities in order to maximize the returns from the programme. There is often a need to intervene to ensure that teachers pass on their enthusiasms and learning as it is very easy for a teacher fellow to return to the classroom and become engulfed again in the demands of their teaching and school programmes.

A series of in-service courses are being organised for the last term of this year and Terms 1-2 of 2003 to further facilitate this. This activity is intended to use exemplary Teacher Fellows to not only promote the scheme but also to disseminate the knowledge, understandings and skills that they gained during their Teacher Fellowship. This activity is being supported from the 1% portion allowed of the fund under the Terms of Reference. The success of this activity will be evaluated early 2003 and, if successful, it may be that we seek a return of the level of the fund allowed for this activity back to the 2% level as previously allowed.

We have also provided more direction this year via a regular newsletter which contains information of interest on current research and innovation to give them a wide range of knowledge and ideas to take back to their classrooms next year. This newsletter has been very well received. Teacher Fellows receive ongoing support and mentoring from Society staff through email contact and visits when possible. This is also achieved through promoting networking within the Teacher Fellowship and with other agencies working in similar areas to each Teacher Fellow.

We have also started to develop the concept of fellowship amongst this year's Teacher Fellows by encouraging them to meet in local areas. This has worked particularly well in Auckland and Upper Hutt where the groups meet regularly for lunch. This concept will be extended next year to include past Teacher Fellows, and efforts will be made to establish these networks in other centres.

Funding of the scheme is now invested by both the Ministry for Research Science and Technology and the Ministry for Economic Development. As a number of Teacher Fellows are engaged in work in the environmental science and environmental education areas, it may be considered appropriate for Ministry for the Environment to also contribute in the future, and the Royal Society would appreciate any assistance and support possible in pursuing this concept.

International Activities

The Royal Society memberships of international academies and other organisations play an important role in assisting New Zealand researchers to gain access to knowledge and innovative technologies developed in the international environment.

Output Eight (Royal Society International Memberships and related Activities) of the 2002-03 Output Agreement provides funding to further the development and enhancement of New Zealand's international science and technology linkages, with the Society investing in programmes that promote science and technology through accessing and utilising the best global ideas. The Society encourages New Zealanders to use international science and technology linkages to enhance New

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

The Society has carried out a comprehensive review of its international memberships during the past 12 months and the Society Council has now approved some recommendations put to its meeting on 3 October. The review revealed that there is considerable merit to not only remain a member of the majority of the existing academies and other organisations with some rationalisation, but to join others who would also provide significant benefits to New Zealand's innovation system.

Accordingly, the Society Council has recommended that the following additional international academies and/or organisations be adhered to:

- International Social Science Council (ISSC)
- International Council of Associations for Science Education (ICASE)
- International Institute of Refrigeration (IIR)
- International Union of Food Science and Technology (IuFOST)
- International Union of Soil Science (IUSS)
- International Federation for Information Processing (IFIP)

To do so, the Society will require an increase in ongoing baseline funding. It is recommended that the baseline funding for the output be increased by $25k to $175k (GST inclusive) to support the joining and ongoing subscriptions of these additional international academies and assisting to keep abreast of rising subscriptions.

A separate request for an increase in baseline funding was forwarded to MoRST in early October.

Science and Technology Promotion

Contestable Fund for Science and Technology Promotion

The Science and Technology Promotion Fund delivers excellent value for money. Each year, up to 15 projects are awarded funding for a variety of imaginative projects that often have matching funding/resources. The impact of these projects is measurable and an expansion of the programme would be an excellent way of investing in science and technology promotion in New Zealand. It is a way of ensuring a good spread of activity throughout the country. These are mostly projects that would not get off the ground otherwise.

We strongly recommend that the fund be increased by at least 50% over the current $400k. A lesser amount would elicit a cynical, rather than appreciative, response from potential applicants. The administration cost would increase by a much smaller proportion, since the number of applications funded has decreased with the removal of the $30k limit.

Royal Society Communicators Programme

Given the end of Output Five and our wish to expand the Communicators Programme, we recommend that extra funding can be provided next year to support the investment the Royal Society has made in the communications/promotions area. Whilst we have been successful in securing other funding to pay for internal travel, functions, lectures, and other above the line costs for high profile visitors such as Lord May and Professor MacDiarmid, it is difficult to get money to pay for staff time. In addition, there is a significant contribution of free time by Royal Society branch members.
The Royal Society is highly competent and experienced at organising these visits, especially the media promotion required to capitalise on them. It plays a unique role in this regard.

It is not desirable to expand the programme within the existing Output Six budget by displacing other valuable programmes carried out by the Royal Society.

Realise the Dream

It is imperative that we fully and proudly recognize the achievements of our young minds, encourage and support them, and use them in return. We would like to build towards a concept such as the Minister's Young Ambassadors for Science and Technology – a group of up to 20 young people who excel in scientific investigation or technological practice. Such a group could be given training in communication (linked with the current Communicator's Programme managed by the Royal Society), profiled as role models, and even offer opinion on RS&T issues to the Minister. This concept will be developed further as plans for *Realise the Dream* develop. The financial support required would be covered by a continuation of the $30k provided this financial year for the development of *Realise the Dream*.

Science and Technology Medals

At a recent meeting of the Royal Society Council, the President Sir Gil Simpson reported that he had met with Sir William Pickering, who had agreed to the use of his name for a Royal Society medal rewarding excellence in technology.

The Council agreed that this medal would have the status of the Rutherford Medal and it was suggested that the Pickering Medal could be added to the New Zealand Science and Technology suite of medals. Accordingly, the Rutherford Medal would be awarded for excellence in science alone, not science and technology.

We recommend that the Ministry consider adding the Pickering Medal to the suite of New Zealand Science and Technology Medals, and increase funding of the medals by an initial $8k to cover the cost of striking the medal, plus $5k annually to cover the costs relating to holding an award ceremony.

Science and Technology Publications

The national science journals published by the Society specialise in results from regional research. Their specialist content is the very reason for the journal's existence. Through the strategies and plans referred to in this report, the Society is committed to continue providing high-quality, well-cited, national science journals with good an established international reputations. After several years of suspension, new Editorial Boards have been established to assist in the process of formulating strategies for the successful future of each journal. With their help, and with the support of the New Zealand science community on whose behalf the journals are published, the Society is confident that the journals will remain as leading flagships for the dissemination of the results of New Zealand's scientific endeavours.

Over the last 10 years that the journals have been published, they have been supported by static ministerial funding with no allowance for the 33% inflation over that period. During that time, journal publishing worldwide has been experiencing a revolution in science publishing on the internet, which has been one of the main contributing factors leading to severe reductions in library subscriptions for printed journals. This has been particularly difficult for regional journals with a regional subscriber base. The resultant reduction in income has been managed in the past by: (1) moderate subscription increases; (2) imposition of a nominal page charge for non-subscribing authors; and (3) the concurrent reduction in production costs made possible by changing to computerised desktop publishing methods at an early stage, and other technological advances in the printing process. Also, drastic reductions in personnel have reduced costs internally but led to a situation where staff are now overloaded and their output is affected.

MARSDEN FUND

1 Overview

1.1 Purpose and Objectives

The Marsden 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.

1.2 Scope and Scale

In 2001/02, the Marsden Fund operated as a separate Output Class under the Knowledge Goal of the RS&T system, with an investment budget of $27.839 m (22.7% of the Knowledge Goal investment, 5.73% of Vote: RS&T).

During the year, 356 research contracts were operational, covering the humanities, social sciences, sciences, mathematics and engineering.

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

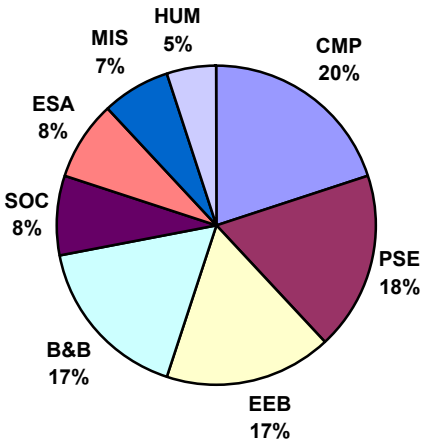


Figure 1: Funding by research area for new contracts in 2001/02.
The research areas are:
Cellular, Molecular & Physiological Biology (CMP);
Physical Sciences and Engineering (PSE);
Ecology, Evolution and Behaviour (EEB);
Biomedical and Biochemical Sciences (B&B);
Social Sciences (SOC);
Earth Sciences and Astronomy (ESA);
Mathematical and Information Sciences (MIS);
Humanities (HUM).

For these new research contracts, 54% of the funding is for the medical and life sciences, 33% for the physical sciences, earth sciences and mathematics, 8% for the social sciences and 5% for the humanities. This is practically the same as for the previous year.

1.3 Providers

Eligibility is unrestricted provided that the research is carried out either in New Zealand or, if its nature demands, carried out elsewhere by New Zealand-based researchers. Over the years, contracts have been awarded to universities, Crown Research Institutes, research associations and institutes, private individuals and companies. Universities as a whole are the largest providers and in 2001 submitted 75% of the proposals, across all areas of research. Proposals from the CRIs represented 19% of the total, mainly in the life and earth sciences, with very few in the social sciences and humanities.

Funding by institutional group in the 2001/02 year is given in Figure 2. Since 2000/01, the CRIs have dropped from 18% to 16%, a similar drop to that recorded the previous year.

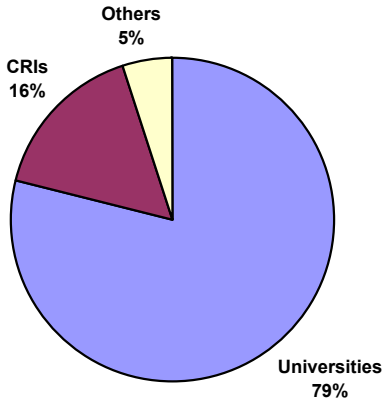


Figure 2: Funding of all contracts current in 2001/02 by institutional type.
For administrative purposes each contract has a lead institution that is used in this figure, although many contracts involve collaboration with researchers at other institutions. The total allocated in 2001/02 was $29.560 m.

1.4 Users

"You must first produce new knowledge and buy a ticket in the membership of new knowledge producers. If you don't have access, you won't be a player"

– Robert Lord May, President of the Royal Society of London.

The Marsden Fund aims to support projects at the cutting edge of their discipline that explore new ideas, develop fundamental understanding and enhance knowledge for future innovation. These projects can lead on to strategic and applied research that, ultimately, provides social, environmental and economic advances for New Zealand. For example, in a sample of NERF programmes, 25% reported Marsden funding for closely aligned research. Projects can also lead to serendipitous discoveries. Marsden researchers participate in research of international significance, ensuring that New Zealand contributes to, and gains from, global knowledge. Knowledge developed in Marsden projects is published and is widely available to other researchers and interested parties, unless there are intellectual property considerations. The Marsden Fund regards the dissemination of knowledge to the general public, through media, community activities and teaching, as an important activity.

The Marsden Fund also fosters people with knowledge, skills and ideas. It supports some of New Zealand's best and most experienced researchers. For example, of the 5 successful applications to the Centres of Research Excellence Fund, 31 directors and principal investigators (57% of total) have been principal investigators on Marsden projects. The Marsden Fund provides significant support for new and emerging researchers for New Zealand's research and innovation system. For new grants announced in 2001/02, the first year of funding provided for 44 FTE postgraduate positions and 26 FTE postdoctoral positions[1]. The Fast-Start programme supported 20 emerging researchers.

2 Progress and Achievements Evaluation

2.1 Achievements

The main achievements discussed this year centre on early-career researchers. During the year, analysis was completed of the survey of postdoctoral fellows and postgraduate scholars, commissioned in collaboration with the Foundation for Research, Science and Technology and the Health Research Council. Also, the Marsden Fund started its Fast-Start programme for emerging researchers.

Survey of Postdoctoral Fellows

Former Marsden-funded postdoctoral fellows were surveyed in 2001 to find out where they are now, what they are doing, and what their attitudes are towards doing research in New Zealand. Results of the survey are given in Appendix I. The main findings are as follows:

- *What they are doing now*
  - The majority of Marsden fellows continued in research, with 86% working as research fellows, scientists, lecturers or professors.

[1] Since not all positions were full-time, the number of distinct postdoctoral positions was 31.

  - Most Marsden fellows were working at NZ or overseas universities, with fewer working at NZ research institutions or CRIs. In comparison to FRST and HRC fellows, more of the Marsden population was overseas. This may reflect the internationally competitive nature of Marsden-funded research and that a relatively higher proportion is likely to be non-New Zealand nationals.
- *Views on career progression*
  - The two factors that FRST/HRC/RSNZ fellows most commonly specified as helping them to gain desirable employment were key work experience and qualifications. The three most commonly specified factors that had constrained careers were inadequate research funding, lack of job opportunities, and inadequate financial rewards. With respect to inadequate financial rewards, we find that most former Marsden fellows who were working in New Zealand earned between $40k and $50k. This is less than those who were working overseas, most of whom earned more than the equivalent of NZ$55k.
  - Dissatisfaction with career progression was expressed by 22% of FRST/HRC/RSNZ fellows. The main reasons given were job insecurity, funding difficulties/insecurity, and a lack of suitable employment opportunities.
- *Perceptions of scheme's effectiveness*
  - 42% said that the Marsden fellowship had influenced their career plans. The fact that more than half felt that it hadn't may reflect well-developed career plans among many postdoctoral fellows.
  - In their first positions after completion of their Marsden fellowships, 90% built on expertise developed during the fellowship. In subsequent positions 78% were still building on this expertise.
- *Attracting overseas researchers back to New Zealand*
  - 20% of Marsden fellows who were overseas said they would like to return to New Zealand, 13% said that they wouldn't, and 66% were unsure. The large percentage who were unsure suggests that there is room for initiatives to attract these people back to New Zealand; the most commonly stated factors that would influence them to return were a job offer, a *desirable* job offer, personal/family reasons, and available research funding.

Fast-Start Programme

The first year of the Fast-Start programme, which provides grants of $50k per annum for 2 years, saw 20 applications funded, out of a total of 177 Fast-Start applications. The effect of the Fast-Start programme has been to significantly alter the profile of the researchers funded by Marsden. For the previous 2 rounds, 26-27% of principal investigators had received their highest degree in the past 10 years. In 2001/02, this increased to 38%. Since the first Fast-Start contracts started in October 2001, it is still too early to analyse the effect on the individuals' research careers.

2.2 Key Indicators

The following key indicators have been chosen to represent the purpose and objectives of the Marsden Fund and have been grouped accordingly.

Excellence in the Advancement of Knowledge	**1999/ 2000**	**2000/ 2001**	**2001/ 2002**
International Presentations – For current contracts (excluding those awarded in the year's funding round), the percentage for which work has been presented at international conferences	67%	63%	65%
Underpinning the Knowledge Base	**1999/ 2000**	**2000/ 2001**	**2001/ 2002**
Contracts – Number of current contracts*	324	330	356
Completion – Number of contracts completed in the year	61	63	88
Publications – For contracts completed in the year, the number of published peer-reviewed papers and conference proceedings	420	441	604
Presentations – For contracts completed in the year, the number of conference and workshop presentations	413	472	612

Broadening and Deepening the Research Skill Base	**1999/ 2000**	**2000/ 2001**	**2001/ 2002**
Investigators – Number of separate individuals acting as principal and/or associate investigators on current contracts	660	729	769
Women – Percentage of female PIs* on contracts awarded in the funding round	18%	18%	25%
Maori – Percentage of Maori PIs and AIs* on contracts awarded in the funding round	1.6%	0.9%	4.0%
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%
Postdoctoral fellows – Percentage of contracts in the year's funding round which involve postdoctoral fellows*	47%	44%	35%
Students – Percentage of contracts in the year's funding round which involve postgraduate students*	47%	70%	49%
Quality of the Research Environment	**1999/ 2000**	**2000/ 2001**	**2001/ 2002**
National collaboration – Percentage of successful proposals in the year's funding round with New Zealand PIs and/or AIs from outside the host institution	30%	25%	20%
International collaboration – Percentage of successful proposals in the year's funding round with PIs and/or AIs from overseas	30%	34%	26%
International collaboration – Percentage of current contracts with international collaboration (excepting proposals funded in the year's round)	73%	67%	67%
Multidisciplinary research* – Percentage of successful proposals in the year's funding round in which more than one discipline is represented† (†according to OECD Research Classification Codes)	40%	41%	37%

***Current contracts** - those operating in the government financial year indicated.
***PIs** - Principal investigators - are researchers who lead the research, contribute the main ideas and are responsible, with their institution, for the achievements of the objectives and the management of the contract.
***AIs** - Associate investigators - are researchers who play a lesser role than principal investigators and sometimes are involved with only limited aspects of the work.
***Postdoctoral fellows** are emerging researchers who have completed a PhD, usually within the last few years, and are employed on contract (often of 2-3 years). They do much of the day-to-day work on the research programme, and are looking to gain experience to establish themselves as permanently employed researchers.
***Postgraduate students** are researchers who are working on a Masters or PhD thesis.
***Multidisciplinary** research is that in which two or more disciplines are brought to bear.

The indicators show continued strong performance in *Excellence in the Advancement of Knowledge* and in *Underpinning of the Knowledge Base*. There have been significant changes in the indicators for *Broadening and Deepening the Research Skill Base*. The main change is an increase in the number of emerging researchers, due to the Fast-Start programme. Also, the percentage of principal investigators who are women has increased significantly, from 18% to 25%. The increase in the percentage of Maori investigators should be treated with caution, as the actual number of investigators is only 8. The drop in the percentage of contracts supporting postdoctoral fellows is misleading and due to the first year of Fast-Start; as a percentage of *standard* contracts, the figure is 47%. The percentage of contracts supporting students returns to about 50%, from an anomalous, high level in 2000/01. While the indicators for the *Quality of the Research Environment* point to a drop in collaboration, indications from applications in 2002/03 are that this is a statistical fluctuation rather than a trend.

Further quantitative indicators and qualitative achievements are included in Appendix II.

2.3 Intention of Investment

The indicators summarised above and detailed in Appendix II show that the Marsden Fund is fulfilling its objectives. Further support comes from the research highlights described in the next section. The Evaluation Officer of the Royal Society is in the early stages of a bibliometric analysis of Marsden Fund research. This will provide an indication of the international standing of Marsden research and will be reported next year.

3 Highlights

3.1 Key Features for 2001/02

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

3.2 Breakthroughs

A highlight this year was the publication of an article in the prestigious peer-review journal *Science*. Researchers reported evidence of global destruction of forests caused by the huge asteroid that hit the Earth 65 million years ago. This story, linked to the extinction of the dinosaurs, achieved international media coverage. On a similar theme, a geologist has discovered that a recent episode of extinction, within the last million years, had a much worse effect on deep-sea life than that caused by the asteroid. The reasons for this have yet to be ascertained. In other earth sciences research, progress has been made towards understanding the process by which New Zealand “coolwater” limestone forms, yielding important information about past climate change events.

In the biomedical sciences, novel methods have been developed for controlling the immune response. In one case, the immune system has been enhanced for use, for example, in anti-cancer therapy; in another, it has been suppressed, as is required for the treatment of degenerative diseases such as multiple sclerosis. One of these developments has already been patented. In other work, different approaches have been investigated for controlling the activity of mitochondria, the energy producing structures of the cell. This has not been possible in the past, and may lead to novel therapies for the neuro- and muscular-degenerative diseases, as well as conditions associated with ageing. Progress has also been made towards finding out what controls the elasticity of artery walls, arteries with low elasticity being thicker and more prone to disease.

In the humanities, this year saw the publication of the long awaited biography of New Zealand journalist, poet, and novelist Robin Hyde. *The Book of Iris*, which was started in 1965 and then put aside, was completed by Robin Hyde’s son, Derek Challis. Two of the New Zealand Print Culture programmes have received considerable media publicity this year. In one, a group of researchers is studying social, political and linguistic aspects of nineteenth century Maori-language newspapers. They have been producing English abstracts for the newspapers that are available on the web. In the second, a researcher has completed two books surveying the vast NZ travel writing collection from the nineteenth and twentieth centuries.

Various projects focus on the uniqueness of New Zealand flora and fauna. One team has studied why native deciduous trees are not common in New Zealand, and have unexpectedly found that the nutrient status of the soil is an important factor – nutrient rich soils favour deciduousness. A group has been looking at the fossil record, taxonomy and phylogeny of ancient rock-like lithistid sponges, to determine their evolutionary history and relationship to other types of sponge. They have described 32 new species in New Zealand waters, and have found fossils in Oamaru that are very similar to living lithistids. From these findings they can make inferences about past climate change events. Other researchers are finding out more about sex determination in tuatara. Those incubated under natural conditions were faster, ran from predators and were probably more aggressive than those incubated in a laboratory, suggesting that they would survive better in nature. However, they have found that artificial incubation is a good method for conservation as it can be relied on to produce either males or females as required, by varying the temperature.

In molecular biology, a team of researchers has found evidence that horizontal gene transfer of antibiotic resistance genes between different species of bacteria is much more widespread than previously thought. This work was published in the high-impact American *Journal of Bacteriology*, and identified by the American Society for Microbiology as one of the journal’s top papers. Many

researchers are studying different aspects of molecular evolution: In a cover article in *Science*, researchers reported that they were able to directly measure a rate of evolution. They achieved this world-first by isolating and analysing ancient DNA from well preserved Adélie penguin bones from Antarctica. A team of researchers has been investigating the molecular mechanisms underlying viral infection of the bacteria that are essential in the cheese making process. This has implications for practices in the dairy industry. Another group has focused particularly on the rapid evolution of insecticide resistance; they have successfully managed to isolate DNA from blowflies that lived 50 years ago, before the introduction of insecticides, and have learnt about the mechanism by which insecticide resistance has evolved. A further group has been studying molecular evolution of a family of mobile genetic elements that readily integrate into the DNA of vertebrates. Their results suggest that these elements gave rise to vertebrate retroviruses such as HIV. And, a team of researchers has made some important findings as to how a particular growth factor influences the development of new muscle tissue.

In the social sciences, a team of researchers has carried out a wide-ranging survey investigating the rights of children in schools, within the framework given by the UN Convention on the Rights of the Child. The results will inform educational policy on participation, recreation, safety and health. Research in Auckland has revealed that the increasing socio-economic and racial stratification of this city makes it comparable to a city in the UK, but its racial concentration is still much less than typical of most US cities. The implications for local government are addressed. A study on the effects of "social capital" has suggested that countries with a high level of social divergence have a correspondingly poor economic performance. A multidisciplinary group is investigating the importance of fern root as a food source for Maori, finding, for example, that it was a preferred food for Maori travellers before the wide availability of flour.

New Zealand researchers continue to make outstanding contributions to theoretical aspects of mathematics and the physical sciences. One mathematician has co-authored a 560-page book, *Geometric Function Theory and Non-linear Analysis*, published by Oxford in 2001 as part of their prestigious series of mathematical monographs; on a topic that intersects many areas of modern mathematics, the book covers the foundations, recent developments, and new approaches for future research. Another mathematician received the first grant anywhere in the world for a topic that has become known as geometric integration; concerned with computational methods of solving equations that cover a wide range of physical phenomena, it is now a burgeoning field. New Zealand physicists have developed the theory of key components of the atom laser, now being tested by groups around the world. A chemist has led the way in using computers to model the properties of glass. On the more applied front, researchers have developed the method of Bayesian statistics and used it in fields as diverse as wildlife management, economics and cosmology. And researchers have identified key aspects of the chemistry that leads to proteins reacting with sugars in the body, causing problems such as cataracts and Alzheimer's disease. Finally, the world leader in the use of magnetic resonance imaging for the study of fluids has characterised the way fluids behave when they are deformed; this is an example of research that increases basic understanding, yet has practical application.

3.3 Research Strengths and Areas Under-Represented

Marsden-funded research is diverse, providing a robust setting for new ideas. New methods and skills developed also provide a launching pad for the exploration of areas of research that may not be foreseen at present but which will be important in the future.

However, projects carried out in the 2001/02 year feature some particular areas of concentration of effort and research strength. These are listed in part 1 of Appendix IV and include protein structure and biochemistry, genetics and molecular biology, molecular evolution, synthetic chemistry, condensed matter and cold-atom physics, climate, several areas of mathematics, psychology and print culture. There are also areas of research that are under-represented – either because there are few Marsden applications in those areas or because the applications have not been successful. These are given in part 2 of Appendix IV.

4 Strategic Direction

The Marsden Fund funds excellent user-initiated research that makes a significant contribution to the advancement of knowledge, underpins the knowledge base and develops the research skill base in New Zealand. Much of the strategic research funded by other agencies has been seeded by Marsden funding.

4.1 Expansion of the Fund

To increase the effectiveness of this form of investment in New Zealand's future, the Marsden Fund Council have a goal to increase the size of the Marsden Fund to $50m by 2005. This involves a substantial increase to the fund from its present level of $30.8m for 2002/03. An increase of this magnitude will enable the Council to introduce new funding initiatives to overcome a number of the present shortcomings the fund is experiencing. These include the low success rate for researchers applying to the Fund, introducing some longer-term awards, and developing new awards for particular segments of the research community such as mid-career researchers and expatriate New Zealand researchers wishing to return to the country.

The low success rate of applications to the Marsden fund remains a major concern. For the 2001/02 funding round only 9.3% of applications were funded. With increased funds available in 2002/03, this has increased to 10.7%. However at this level the fund compares poorly with international success rates for similar funds. For example the Australian Research Council targets a success rate of 25% for its Discovery Grants. The Marsden Fund Council note that each year there are a significant number of applications that reach the excellent standard required for a Marsden award but are unable to be funded. A related concern is the relatively high cost for the research community of preparing applications for a fund with a low overall success rate.

Compounding this situation is the rate of increase in the amount of funds requested in proposals and the consequent size of the funds awarded to individual projects. The introduction of the Fast-Start scheme in 2001/02 with a fixed sum of $50k per year has had an impact, but the average size of Standard Marsden awards increased from $129,491 in 2000/01 to $146,380 in 2001/02. In the 2002/03 funding round, just announced, the average size of Standard proposals funded is $172,334. This increase is a reflection of both a real increase in the cost of undertaking research and the impact of the research providers increasing their overhead rates to better show the full cost.

An increase to the fund for 2003/04 would be used to address the low success rate by funding more of the current Standard and Fast-Start awards. Future increases would be used to expand the range of awards made.

4.2 Expansion of Support and Administration Activities

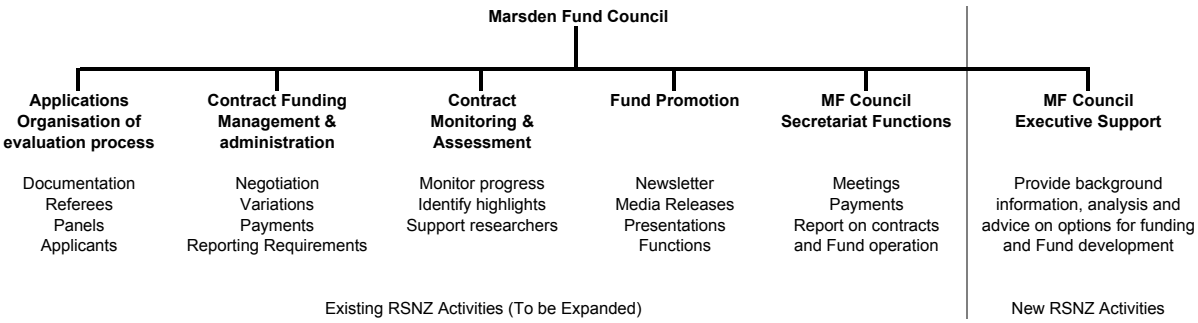
The establishment of the Marsden Fund Council to replace the former Committee has created an expectation of new roles, responsibilities and support functions for both the Council and the Royal Society. The recently signed MOU between the Council and the Royal Society describes the anticipated arrangements. In particular, the Council will take a stronger role in

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

In addition to its fund administration activities, the Royal Society as the executing arm of the Fund, will undertake

- more policy analysis and advice to the Council.

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



To be able to provide the additional services and functions, the Royal Society will need expand its support team by recruiting new staff with a policy advice background. This additional capability will be critical in 2003/04 for providing the Council with information on the options for future development of the fund and the benefits to be delivered from new types of awards.

An increase in the funds provided for administering the fund is also needed to address another concern, the low percentage of applicants of Maori descent, and the even lower percentage of Maori on successful applications. For the 2002 funding round, although the proportion of Maori applicants did increase from 2% to 3% of all applicants compared with the 2001 round, the proportion of Maori researchers on the successful proposals fell from 3.1% to only 1.7% (4 researchers among 237 being funded). The Council has directed that additional effort be placed on making the Maori research community aware of the opportunities to be gained from Marsden funding and ensuring that evaluation process are responsive to Maori needs.

An adjustment in the funding for the administration activities is critical. Section 6 describes the increased workload for the Royal Society as the fund has increased. If the operational funding remains static, it will be necessary to reduce the monitoring and assessment and some promotion activities to compensate for the increases to the size of the fund already signalled for the next three years in order to provide a robust selection round each year and to provide the minimum level of secretariat services to the Marsden Fund Council.

An increase in administration funding would be targeted at

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

5 Memorandum of Understanding between the MFC and the Royal Society

The creation of the Marsden Fund Council (MFC) has led to an expansion in the role and function of that body compared with the former Marsden Fund Committee. To ensure that there is clarity in the relationship between the MFC and the Royal Society and in the various functions that each body undertakes in respect of the Marsden Fund, a Memorandum of Understanding has been developed and was signed on 20 September 2002.

The MOU recognises the functions of the MFC as set out in the Terms of Reference for the Marsden Fund issued by the Minister, and the responsibilities of the Royal Society as contracted in the annual Output Agreement. In particular the MOU describes the governance and direction the MFC will provide to the Royal Society in relation to the management of the Fund, and the responsibilities the Royal Society will have in administering the fund and providing executive support to the MFC.

In terms of the MOU, this section of the Progress and Achievements Report is the formal report to the Minister as required in the Terms of Reference for the Marsden Fund.

To undertake its expanded role, the MFC now requires increased support from the Royal Society. Previously, support was in the nature of a secretariat, organising meetings and providing information arising from the administration of the research contracts. The envisaged support for the future is more in the nature of executive support, including policy analysis and advice on the impact of Marsden funding and on future directions for the Fund. The implication of this change for the Royal Society is detailed in Section 4.2.

6 Funding Support and Execution

There was no change in the funds provided for administering the Marsden Fund in 2001/02 despite the fund itself increasing from $25.8m to $27.8m. The fund has risen to $30.8m for 2002/03; however there was no increase in the administration fee, apart from $70k to provide increased honoraria for the MFC members.

In the three years from 1999/00, the fund has increased in size by 35% and it is scheduled to increase by a further 12% over the next three years. Changes of this magnitude lead directly to increased resource requirements for handling and evaluating the applications, and for administering the projects that are selected for funding (negotiating contracts and the monitoring and evaluation activities). The resources required to maintain the high standard of application evaluation, research contract monitoring and fund evaluation will not be able to be provided within the current administration funds provided.

The table below summarises the recent growth in the Marsden Fund together with the indicative increases signalled by the Minister.

	1999/00	**2000/01**	**2001/02**	**2002/03**	**2003/04 est.**	**2004/05 est.**	**2005/06 est.**
Fund Size	$22.8 M	$25.8M	$27.8M	$30.8M	$31.8M	$33.4M	$34.4M
Applications							
Preliminary	773	756	884	801			
Full	132	136	179	165			
New Contracts awarded	74	73	82	86			
Active Contracts	329	336	356	365 (est.)			
Fee (incl GST)	$946.7k	$1,142k	$1,142k	$1,212k	$1.558k	$1.637k	$1.686k
% Cost/ Fund size	4.2%	4.4%	4.1%	3.9%	4.9%	4.9%	4.9%

The table also shows the fee paid to the Royal Society to administer the Fund. The last significant increase was in 2000/01 to provide additional funds for additional reporting and monitoring, database development and fund promotion. The small $70k increase in 2002/03 was to compensate for the increase in honoraria to the MFC members and did not provide for the additional costs of administering a larger Fund.

The nature of the Marsden Fund, with emphasis on peer review, contract administration and evaluation, means that the Royal Society is unable to continue to absorb all the increased costs of providing high quality administrative services for the Fund. In 2000/01 the Society was able to deliver $22.6m of funding per $1m of delivery cost. It proposes to deliver $24.1m of funding per $1m of delivery cost in 2003/04 – a productivity increase of 5%. Therefore the Society recommends that fees for the MFC, plus the increased delivery support required by Council, be increased only to 4.9% of fund. For 2003/04 this would imply a fee (incl GST) of $1.558m. The consequence of not adjusting the operational funding will be a decline in the quality of the support services provided for the Fund.

SUPPORTING PROMISING INDIVIDUALS

JAMES COOK RESEARCH FELLOWSHIPS

1 Overview

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

The fellowships are awarded as funding permits in the following categories:
- Biological sciences;
- Engineering sciences and technologies.
- Health sciences;
- Physical sciences;
- Research of relevance to the peoples of New Zealand and/or the Southwest Pacific;
- Social sciences.

The fellowships have the following objectives:
- To encourage sustained excellence within the particular disciplines covered by the fellowship;
- To strengthen existing and new research within the particular disciplines covered by the fellowship.

Fellows are selected on the basis of:
- their academic and research record;
- scientific and technological merit of the proposed research;
- scope for intellectual and scientific development of the individual researcher;
- strengthening of existing and new research within the discipline;
- intellectual and logistical support offered by the host institution.

2 Progress and Achievements Evaluation

In the 2001-02 funding round, three fellowships were awarded, one in each of the following areas: Physical Sciences (eight applications received); Biological Sciences (eight applications received); and Research of Relevance to New Zealand and the South-West Pacific (13 applications received).

During 2001-02 there were eight active James Cook Research Fellowships. These are listed in Appendix V.

Professor Judith Binney asked for a one-year extension to her fellowship and an extension has been approved until April 2003. Associate Professor Robert Poulin FRSNZ, (Biological sciences) and Professor Erik Olssen FRSNZ (Research of relevance to the peoples of New Zealand and the South West Pacific) were awarded fellowships in early 2002 but did not take them up until 1 July 2002.

Applications in the areas of Biological Sciences, Engineering Sciences and Technologies, Health Sciences and Social Sciences are being called for at present for fellowships to start in April 2003.

The Royal Society, via its Academy Council, receives 6-monthly and final James Cook Research Fellowship reports and general summaries and these are assessed by academy councillors with expertise in the particular discipline for the quality and progress of the research. All Fellows have shown that progress with their research within any one 6-month period is very satisfactory. In all instances there has been clear evidence of progress towards the stated goals and that the achievements have added to the knowledge base within the particular disciplines. Fellows report that without the distraction of administrative burdens within their institutions, they are able to accomplish significantly more that usual.

3 Highlights

Three Fellows finished their fellowships within the 2001/2002 period and all produced excellent research during their tenureship. One Fellow's research is highlighted below.

Dr Michael Eccles completed his fellowship studying "Strategic targets for cancer therapy and proliferative disorders" in March 2002. He has been studying how cells participate in the formation of organs such as the kidney during foetal development, and how this process might be induced in cultures of cells outside the body. Most of his work was carried out in collaboration with researchers at McGill University, Canada and at Harvard University, USA.

The main achievements are:

- generation of a working model of how kidneys develop;
- development of a method for treating genetically mutant small kidneys in culture so that they grow to a normal size;
- characterisation of several major molecular pathways in kidney development;
- identification that multiple genes are over-active in cancer, and evidence that these genes may be very good therapeutic targets;
- partial correction of fatal polycystic kidney disease in mice carrying the polycystic kidney disease mutation, through genetic manipulation; *and*
- a new and efficient technique for delivering genes into cells for the purpose of gene therapy.

Research in all of these areas is continuing in Dr Eccles' laboratory even though he has finished his fellowship.

During his fellowship, Dr Eccles published 7 scientific papers, had 2 book chapters accepted for publication, and developed one patent (pending). In addition, 6 papers and two more patent applications are in preparation.

It is anticipated that this work will lead to advances in the treatment of certain cancers (eg. renal, ovarian, prostate), and of polycystic kidney disease. The work may also ultimately allow growth of new organs, such as kidneys, in culture, for therapeutic purposes. This would circumvent problems such as rejection that are encountered in organ transplants.

Survey of James Cook Research Fellows
In order to find out what effect the fellowships have on the Fellows, their research and the people they work with, and to find out how Fellows think the scheme could be improved, we interviewed the seventeen researchers who were awarded James Cook Research Fellowships between 1996 and 2001. An analysis of the results is presented in Appendix VI.

The main findings are:

- all former James Cook Fellows continue to be leading researchers;
- James Cook Fellowships fund research that wouldn't have been possible otherwise, and do so by:
  - providing uninterrupted time for research;
  - funding Fellows to work overseas;
  - funding research that would not have been funded by any other scheme;
  - providing a source of salary.
- Fellows' further work continues to build on the James Cook-funded research;
- Fellowships have a positive effect on not just the Fellows' careers, but also on the careers of Fellows' staff and students;
- The stipend level is inadequate for two reasons:
  - it is inadequate for Fellows who go overseas
  - it is less than recipients' normal salaries. Some institutions compensate for this by topping-up the fellowship, but this has led to problems in some cases.

4 Strategic Direction

Role Modelling
James Cook Fellows are very talented people who are doing exciting research. As such, they are ideally placed to act as role models for school students and undergraduates by going out and

speaking to them, and acting as mentors. In addition, several Fellows have expressed a desire for better publicity to be provided for Fellows and their work (see Appendix VI). In order to make more use of Fellows' talents, and to provide better publicity for them, we are building James Cook Research Fellows into the Communicators programme that the Royal Society has established.

Targeting
The fellowship Terms of Reference stipulate that the fellowships be awarded to senior researchers who are recognised leaders in their respective fields". However, we have anecdotal evidence that some researchers are discouraged from applying because they don't feel they fit the "senior" category. It is the Royal Society's view that the fellowships would be better targeted to those who are recognised leaders in their fields, irrespective of whether or not they are "senior" researchers. This would require a change in the wording of the Terms of Reference.

Level of Stipend
Funding of the scheme is a matter, which needs attention. The current stipend is set at an associate professor level salary ($90k), plus several thousand dollars for research expenses. As the survey showed (Appendix VII), it is insufficient for Fellows who carry out their research overseas, and this may be deterring more recent applicants from planning to go abroad during their fellowships. It has also led to problems associated with institutional top-ups to Fellows' stipends

Only one Fellow (Dr Ken MacKenzie) in the past five years has spent his entire period of his fellowship overseas. In his final report to the Royal Society he reported: "this James Cook Fellowship has produced results which were extremely beneficial on several levels……. *These benefits were maximised because I opted to spend the entire period of this fellowship overseas at a prestigious university.* These opportunities….would not have been so readily available had I remained in my own institution in New Zealand. However, the decision to spend the entire period of the fellowship at Oxford was not without significant financial penalty, due to the declining value of the New Zealand dollar….. and to the comparatively higher cost of living in Oxford. Had it not been for the availability of financial assistance from my own institution and for my willingness to subsidise some of the costs from my own pocket, it would not have been possible for me to have undertaken this fellowship at Oxford on the amount of money which it presently provides".

We recommend that the fellowship stipend be raised to $110k /year plus up to $10k /year expenses. This would bring the stipend up to a level equivalent to a professor's salary, taking into account the fact that GST is deducted, and it would significantly ease the financial burden on Fellows who go overseas. This would require an increase in funding from $720k to $840k per year.

SCIENCE, MATHEMATICS AND TECHNOLOGY TEACHER FELLOWSHIPS

1 Overview

1.1 Purpose and objectives
The New Zealand Science Mathematics and Technology Teacher Fellowships offer primary and secondary teachers of the sciences, mathematics and technology the opportunity to improve their teaching with an injection of 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 and become more skilled in the communication of science and technology. Whatever they do, the evidence shows that the teachers return to the classroom and their students rejuvenated and inspired (Science and Technology Teacher Fellow Evaluation, Jordan and Galt, 1999). They pass that inspiration and enthusiasm on to their students.

The New Zealand Science Mathematics and Technology Teacher Fellowship is a part of the Supporting Promising Individuals output class. As such, it contributes to supporting human resources in research, science, and technology and contributes to the development of people with knowledge, skills and ideas. This output class contributes primarily to the Knowledge Goal, and this report will demonstrate the contribution made by New Zealand Science Mathematics and Technology Teacher Fellowships in terms of professional development of teachers, contribution to new knowledge and innovative practice, and awareness of opportunity for teachers and school pupils.

This year has to go down as one of the best experiences that I have had the opportunity to have. The chance to work on tasks that push me outside my comfort zone and within timeframes that I set myself has certainly been great. I found the beginning of the year quite stressful as I listened for bells to tell me when to do things or looked over my shoulder to see someone I was accountable to. It was quite a revelation to discover that, apart from the Royal Society and my Hosts, I am mostly accountable to myself. I followed that with a strong drive to organise myself so that I could get the most out of the year.

Jeff Lockhart, Papakura High School

1.2 Scope and scale

The New Zealand Science and Technology Teacher Fellowship scheme is currently funded at $3.1m which includes a contribution of $750k from the Ministry for Economic Development.

The management fee for operating this scheme is currently $210k which will be inadequate for the increased number of awards for 2003. The last increase in management fee was made in 2000-01.

The number of Teacher Fellowships awarded has increased since 1994:

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

There were 120 applications for the 2003 school year compared to 112 for the 2002 school year. An increase in the number of quality applications enabled accumulated reserves to be used in the selection of 58 Teacher Fellowships for school year 2003. The number able to be awarded for 2004 will be less as the accumulated funds are depleted.

A highlight for the year was the 300% increase in applications from teachers of social sciences for 2003.

1.3 Characteristics of Teacher Fellows

Apart from an imbalance in the first three years of operation, a gender balance has been maintained over the past seven years. This is however somewhat misleading as there is a much greater proportion of female primary teachers and so one would expect this to be reflected in the awards made. Off-setting this though is the under-representation of applicants, and therefore awards made, from primary teachers even though proportionately more primary teachers are awarded fellowships.

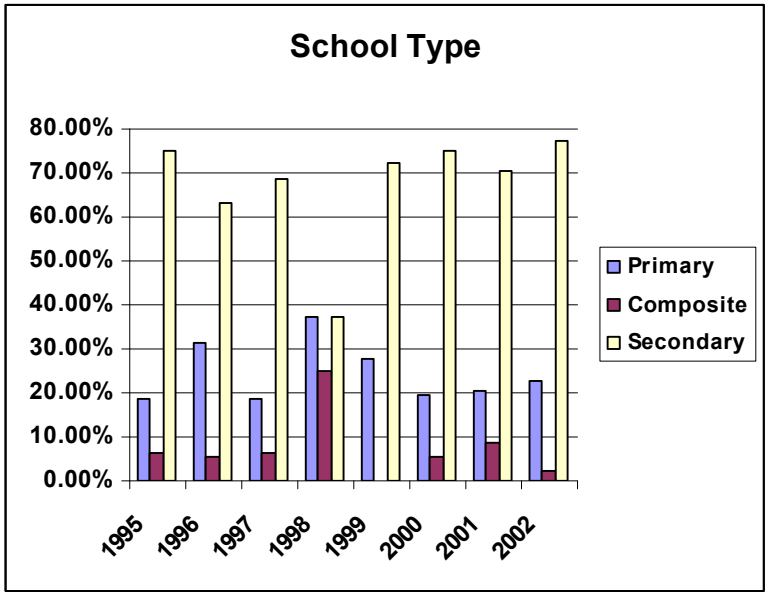
Table 1: Gender of Teacher Fellows

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

This under-representation of awards to (and thus applications from) primary teachers is shown clearly in Table 2.

Table 2: School type

School Type	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Primary %		19	32	19	38	28	19	21	23
Composite %		6	5	6	25	0	6	9	2
Secondary %	100	75	63	69	38	72	75	71	77



There are a several reasons for this phenomenon, most of which are related to the different nature of qualification, training and experience of primary teachers, which are outlined later in this report.

Decile ratings are a socio-economic indicator for the community within which a school is situated. These ratings are derived from a complex set of factors which include indicators drawn from the general community and from school rolls. Deciles are revised every census, and significant change may occur. However note that, as this is a comparative measurement, there are approximately 10% of schools within each decile rating.

Table 3: Decile rating (percentages) of schools with Teacher Fellows

Decile	1995	1996	1997	1998	1999	2000	2001	2002	Average
1	5	11	13	25	6	14	18	4	11
2	21	5	0	13	11	11	12	2	8
3	11	5	6	6	17	14	0	2	7
4	16	16	0	6	17	11	9	10	13
5	16	21	13	19	6	6	15	6	12
6	11	5	6	0	0	8	6	10	6
7	11	21	25	0	0	11	18	15	13
8	5	0	19	6	17	17	9	17	11
9	0	5	6	19	22	6	12	19	11
10	5	11	13	6	6	3	3	15	8

It can be seen from Table 3 that representation from schools in particular socioeconomic categories fluctuates markedly year by year. However there has been, over the years, a reasonable balance in award of teacher fellowships to schools in all socioeconomic settings.

Geographic spread for Teacher Fellowships (Table 4) demonstrates that, while there may be variations on a year by year basis, over time these fluctuations even out. The West Coast and East Coast regions are under-represented over the time of the scheme.

Table 4: Geographic distribution of Teacher Fellows 1994-2002

Geographical Area	1995	1996	1997	1998	1999	2000	2001	2002
Auckland	4 21%	2 11%	2 13%	7 44%	1 6%	10 28%	17 40%	15 31%
Bay of Plenty	4 21%	1 5%	1 6%	 0%	1 6%	1 3%	1 2%	1 2%

Canterbury	6 32%	4 21%	4 27%	4 25%	2 11%	3 8%	1 2%	8 17%
Chatham Islands	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Correspondence School	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
East Coast	 0%	 0%	 0%	 0%	 0%	1 3%	 0%	1 2%
Hawkes Bay	1 5%	 0%	1 7%	1 6%	1 6%	4 11%	2 5%	 0%
Manawatu-Wanganui	 0%	 0%	2 13%	 0%	2 11%	3 8%	7 17%	3 6%
Marlborough	 0%	 0%	 0%	 0%	 0%	1 3%	 0%	1 2%
Nelson	1 5%	1 5%	 0%	 0%	 0%	 0%	3 7%	3 6%
Northland	1 5%	1 5%	 0%	1 6%	 0%	1 3%	1 2%	1 2%
Otago	 0%	4 21%	2 13%	2 13%	1 6%	4 11%	1 2%	5 10%
Southland	 0%	 0%	 0%	 0%	2 11%	1 3%	1 2%	1 2%
Taranaki	 0%	 0%	 0%	 0%	2 11%	 0%	1 2%	 0%
Waikato	1 5%	2 11%	2 13%	 0%	2 11%	2 6%	 0%	3 6%
Wellington	 0%	4 21%	1 7%	1 6%	4 22%	5 14%	7 17%	6 13%
West Coast	1 5%	 0%	 0%	 0%	 0%	 0%	 0%	 0%
TOTAL	**19**	**19**	**15**	**16**	**18**	**36**	**42**	**48**

Subject distribution similarly fluctuates from year to year (Table 5), but balance is maintained over time. It must be remembered that many activities span two school subject areas and so, for example, a biotechnology activity is recorded for Biology and Technology.

Table 5: Subject distribution of Teacher Fellowships

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Chemistry	3	2	3	2	1	2	1	
Biology	4	4	2	2	4	11	7	
Physics	1	1			2		3	
Earth Sciences	2	1	1		1	1	3	
Astronomical sciences	1		1			1	1	
Science	4	6	1	3	2	3	7	
Agriculture/ Horticulture	2			1	1	3	1	
Technology	5	6	5	4	5	15	15	
Mathematics		1		1		5	3	
Environmental/Resource Management	3	3	3	3	4	4	12	
Geography			1		1		3	
Bioethics			1					
Anthropology/Archaeology							1	

Music						1		
Art							1	
Special needs				1				

This year has exceeded all my expectations. The opportunities, experiences and learning have all exceeded that which I anticipated. The learning I have gained, both professionally and personally, will be of enormous benefit to my teaching practice.

I am certainly broadening 'my knowledge and understanding of conservation issues from scientific and technological perspectives.' To work alongside people who are passionate about science, technology and conservation has been a privilege. Their knowledge and enthusiasm is infectious.

In working with Watercare I have increased my knowledge of water catchment, treatment, disposal, management and conservation – in the field, in laboratories and in plants' and have learnt very simple scientific procedures of water testing in the field. A highlight has been time spent out at the dams and filter stations in the Waitakeres and at the wastewater treatment plant.

Rena Heap, Woodlands Park School, West Auckland

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

171 of the 180 past Teacher Fellows (1994 to 2001) were located and interviewed about what they have been doing since completion of their fellowships. A full report is given in Appendix VIII; the main points are as follows:

- 92% had returned directly to school teaching after completion of their fellowships;
- 77% were teaching in schools at the time of the survey; this is slightly less than the percentage who would be expected to be teaching according to Ministry of Education statistics;
- 17% have left school teaching, but still contribute to the education sector as teachers of children outside the classroom, as tertiary or College of Education teachers, as developers of educational resources, or as advisers to schools or teachers. Thus, 94% of ex-Teacher Fellows are currently either school teaching or contributing to education in other ways.
- Only 1.2% (2 Fellows) have taken up jobs unrelated to teaching; Teacher Fellowships are not a means whereby teachers leave the education sector;
- Importantly, a number of the Teacher Fellows who have left school teaching have initiated highly original educational programmes. Highlights are:
  - Pete Sommerville (1995 Teacher Fellow)established the internationally acclaimed Linking Education with Antarctic Research NZ (LEARNZ) programme which has, over the years, taken several hundred thousand school pupils on virtual field trips;
  - Ross Petersen (1998 Teacher Fellow) joined the Electrotechnology Industry Training Organisation and has developed the National Certificate in Electrotechnology qualification (NZQA registered) and the Bright Sparks competition for school pupils;
  - Peter Sadd (1999 Teacher Fellow) is now producing electronics kits to resource science and technology programmes in schools.
  - Ro Bairstow (2000 Teacher Fellow) is now managing maths-online, an internet mathematics teaching programme which supports and assists thousands of teachers and pupils learning mathematics. This programme was this year acknowledged by winning the NZ Marketing Bizam Award for its category (*Marketing Magazine August 2002*)

In conclusion, the majority of Teacher Fellows have returned to, and stayed in, school teaching. Most of those who left teaching have continued to contribute to education, often in highly creative and entrepreneurial ways that reach many more students than could be reached by teaching in a classroom.

2 Progress and Achievements Evaluation

2.1 Contributions to knowledge

Achievements of the programme have been demonstrated by the review by Jordan and Galt, the comments above and can also be seen in the high level of continuing involvement and contributions by previous teacher fellows in the wider science and technology sector. Contribution has been made through presentations to conferences, papers in professional publications, and involvement in curriculum and qualifications developments (especially through Ministry of Education and Colleges of Education contracts).

In 2001-02:

- 32 workshops and seminars were presented at Scicon (the biennial conference for teachers of science) by present and past Teacher Fellows,
- 1 at the Home Economics Teachers conference,
- 5 at TENZ01 (teachers of technology conference), and
- 3 at the NZ Association for Environmental Education conference;
- 1 past Teacher Fellow currently directs a Ministry of Education ICT professional development contract for the Hutt Valley,
- 2 past Teacher Fellows are part of other Ministry of Education PD contracts, and
- 6 Teacher Fellows have undergone Environmental Education Facilitator training.

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

Steve Lawrence, Gisborne Girls' High School

3 Highlights

These include, for 2001/02:

The contribution to new knowledge made by teacher fellows

- Research into the effect of temperature on egg maturation of *Parastrongyloides* (a worm parasite of possums) by Angela Campbell
- Establishment of an artificial reef from waste concrete by Jon Jaffrey in the Long Bay Marine Reserve and monitoring of colonisation of this reef.
- Research into revegetation via seedballs by Robert Guyton, and the international recognition of this work.

The increasing contribution to public understanding through media exposure of projects, particularly the extensive involvement of:

- Jacky McLaren in speaking and radio contributions to the GE debate; and
- Chris Janes in his research into water quality of Lake Horowhenua.

The recognition received for Jeff Lockhart's exhibition of paintings and for the *mathsonline* website established by Ro Bairstow.

The appearance on TV3 News by Peter King regarding his mainland sanctuary work in the Waitakere Ranges (and impending feature on *Maggie's Garden Show*).

It is important to remember that those teachers who are awarded teacher fellowships are those that have demonstrated initiative, contribution to science, mathematics or technology education, and are innovative, and so are the ones most likely to take other opportunities and have the drive to make these succeed. The tracking of the former teacher fellows who no longer teach in schools demonstrates this clearly through their development of highly original educational programmes which impact upon many more pupils than possible in the traditional school setting. All of these activities developed directly from the individual teacher's experiences on the Teacher Fellowship and their passion for teaching. All are now established and sustainable activities enabling many more young people to be reached than is possible within the traditional school structure and setting.

"My time so far as a Teacher Fellow has been very beneficial. I have been able to spend time working with and sharing ideas with people who work in the field of social science research. This has opened my eyes to the depth of research that occurs when preparing for what on the surface appears to be a simple project.
… has changed my perspective on the emphasis that needs to be placed on different steps in the process (social science research). Where as before I would put more time on the recording and using phase of research, I would now put more emphasis on locating and finding … and also on evaluating those resources as valid … Emphasis on evaluation as an integral part of the whole process rather than an end task is also an area to be reinforced."

Sherryl Allen, Mangaroa School

4 Strategic Direction

There are still several factors which present barriers to a teacher making application, such as:

1. the current work-load– teachers are focused on their students and their school and any activity outside of this receives low attention;
2. the introduction of new qualifications systems and adoption of new curriculum statements – teachers are reluctant to be absent from school while these are being embedded;
3. a dire shortage (lack of in the case of Maori speakers) of replacement teachers – Boards of Trustees will not release teachers unless satisfactory replacement teachers are available;
4. a reluctance by some Principals to allow the promotion of the scheme at their school;
5. a continuing (but improving) lack of awareness of the programme by teachers
6. a perception, particularly by primary teachers, that they are not qualified to put forward an application; and
7. an increasing difficulty in obtaining suitable members of selection panels.

The first four factors are beyond the control of the Society, but the fifth and sixth are actively addressed through promotion of the programme and support provided to applicants by Society staff and previous teacher fellows. This is clearly demonstrated by the increase in applications from teachers of social sciences.

Primary teachers are those most inclined to feel that they are not worthy of applying or that they do not fit the criteria. The nature of the background of primary teachers in that they are generalist teachers rather than specializing in one or two subjects also presents extra challenges when considering an application. It may be difficult for a primary teacher to find suitable activities or hosts. This situation may improve as a result of requiring Teacher Fellows to visit schools and give a presentation on the scheme. The in-service courses by primary teacher fellows for primary teachers planned for late 2002–03 should also help address this issue. These are opportunities for the knowledge and understandings of selected projects to be further disseminated to colleagues as well as for promotion of the scheme.

Advice and guidance from Society staff is also openly offered to applicants in an attempt to assist potential applicants, especially those from primary schools.

The profile and level of activity in the environmental education area has increased in line with the initiatives in this area from Ministries of Education and Environment. The activities of about 30% of the 2002 Teacher Fellows involve environmental sciences. As a result, we will establish a separate selection panel in 2004 for applications in this area.

5 Funding Support and Execution

In addition to the so far voluntary panels (involving 21 people), 4 Society staff are directly involved: manager, administrator, and 2 other education staff who provide advice (internally and to applicants) and monitor selected Teacher Fellows.

Experience with the increased number of awards made for 2002 indicates that there is a threshold beyond which the demands on time increased significantly particularly in terms of monitoring and support through the fellowship year. The considerable unrest in the school sector this year due to industrial action and the introduction of NCEA undoubtedly exacerbated this even though the Teacher Fellows were not in the classroom for the year. Given that even more awards (58) have been made for 2003, an increase in management fee is sought for the 2003 academic year if support is to be provided at the same levels as for this year.

Monitoring and evaluation of Teacher Fellows includes bringing them together for a briefing as well as visiting them at their host organisation and meeting their host(s). Usage of the accumulated funds enabled selection of 13 Teacher Fellows for 2003 above the contract requirements.

PROMOTING A CULTURE OF INNOVATION

INTERNATIONAL SCIENCE AND TECHNOLOGY (ISAT) LINKAGES FUND

1 Overview

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

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

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

The fund is also aimed at the younger qualified researchers, or where there are new linkages or activities. The programmes include:

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

The fund does not aim at full-cost funding, but rather, the emphasis is on providing marginal funding for activities, which promote the establishment of new science and technology relationships throughout the world.

2 Progress and Achievements Evaluation

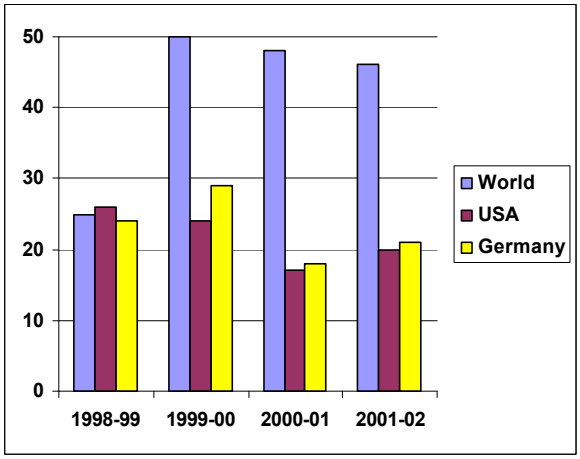
Applications for funding are called for one or twice yearly with panels of five or six eminent scientists evaluating the applications and to provide recommendations for funding.

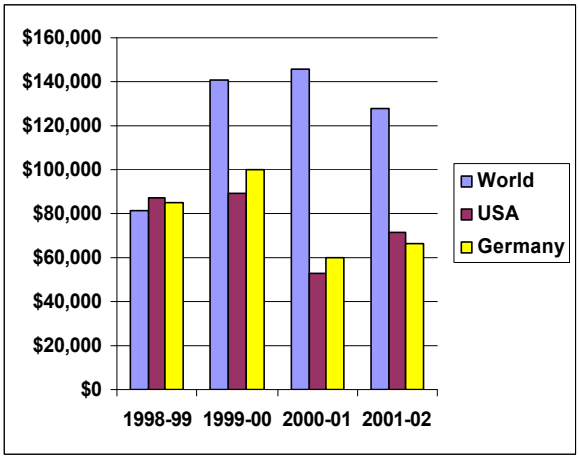
In the year to 30 June 2002, 160 applications were received with 87 (54%) receiving funding. The total funding allocated for the four programmes was $265,320.

The following table sets out the total number of applications received (by programme) and the total number of the applications supported and the value (also by programme) for 2001-02.

ISAT Programme	Number of Applications Received	Number of Contracts Awarded	Amount of Contracts (GST incl)
Bilateral Research Activities Programme	86	46	$127,640
NZ/USA Cooperative Science Programme	40	20	$71,350
NZ/FRG Scientific and Technological Cooperation Agreement Programme	23	18	$53,930
NZ/DFG Programme	11	3	$12,400
TOTAL	**160**	**87**	**$265,320**

The following graphs show the numbers and the values of ISAT contracts issued for the 4 years to 30 June 2002 ("World" covers all countries other than Germany and the USA).





The collaboration between New Zealand researchers and international colleagues and laboratories most often leads to the New Zealand researcher gaining new or enhanced innovative ideas.

Many of the recipients advise that they are much better placed to seek mainstream funding for ongoing research after the initial collaboration has been completed and in many cases, there are significant long-term benefits to New Zealand resulting from continued and ongoing collaboration with internationally recognised experts. The use of state-of-the-art equipment, which is unavailable in New Zealand, is also considered to be a valuable component of the collaborations. In addition, several collaborations have resulted in the intent to publish the results of the research.

While the baseline value of the programmes has remained static at $245k (GST inclusive) the Ministry provided an additional $25k for the 2001-02 year ($40k in 2000/01, $80k in 1999/00 and $20k in 1998/99) and an additional $50k has been provided in 2002-03. Since the Society has been administering the fund more than $1,107k has been allocated to researchers for collaboration with 37 different countries – details are listed in Appendix IX.

3 Strategic Direction

The majority of the universities and crown research institutes find that the linkages are very valuable to both the organisation and to the individual researchers themselves. This is despite the level of funding, generally perceived as low, and the application process which is considered by some to be time-consuming and arduous.

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

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

4 Funding Support and Execution

The fund has received an average funding increase during the past 4 years of $41,250 or 17% above the baseline (an increase has already been provided for in the 2002-03 year as well). While this additional funding is always appreciated it does mean that the Society incurs overhead expense beyond that which is part of the Research Contract Management fee.

5 Highlights

Of the 87 contracts awarded for the year, 17 (20% of) researchers hosted their collaborative partner in New Zealand, which allowed for a much wider dissemination of knowledge and the utilization of overseas advances in research through the institutions conducting workshops etc while the visiting researcher was in New Zealand.

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

Other International Activities

1 Overview

On behalf of the Government the Royal Society is a member of, and maintains close links with, the International Council for Science (ICSU), 16 international unions and 11 scientific associates and committees – a full list is attached as Appendix X. The activity also provides support to New Zealand delegates attending international general assemblies/congresses and meetings etc and limited seed funding to allow international conferences/fora etc to be held in New Zealand.

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

2 Progress and Achievements Evaluation

International Memberships
During the past year the Royal Society has undertaken a comprehensive review of the international memberships. International links are unanimously viewed as being important because they enable New Zealand researchers and research organisations to:

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

The review revealed that there is considerable merit to not only remaining a member of the majority of the existing academies and other organisations with some rationalisation, but to joining others who would also provide significant benefits to New Zealand's innovation system particularly areas such as the social sciences and education.

The review considered the following points:

- *Current situation: New Zealand's S&T memberships, benefits and responsibilities. What regions/disciplinary linkage has New Zealand developed in recent years?*
- *The International players: Current international S&T groupings by region and by (inter-) disciplinary groups.*
- *New Zealand's knowledge base: an inventory of strengths and weaknesses.*
- *New Zealand strategic future: Needed and developing strengths.*
- *Target relationships: what regions/ by (inter-) disciplinary linkages should New Zealand join? Are any current relationships redundant or non-productive*
- *Maximising Effectiveness: the benefits to New Zealand from new relationships*

Accordingly, the Society Council has recommended that the following additional international academies and/or organisations be adhered to:

- International Social Science Council (ISSC)
- International Council of Associations for Science Education (ICASE)
- International Institute of Refrigeration (IIR)
- International Union of Food Science and Technology (IuFOST)
- International Union of Soil Science (IUSS)
- International Federation for Information Processing (IFIP)

Subscriptions to the present memberships of international academies and other organisations remain a concern as they continue to increase each year. At present the Society affiliates on behalf of the government to a wide range of non-governmental international scientific academies and other organisations - the International Council for Science (ICSU), fifteen unions, and twelve scientific associates (the full list is attached) at a cost this year of $NZD91,312. Comparing 2000 with 2002 there has been a 11% increase in the membership subscriptions - $NZD82,250 in 2000 compared with $NZD91,312 in 2002. Indications show that further increases can be expected for 2003.

It should be noted that the Ministry of Foreign Affairs and Trade (MFAT) was approached in March 2002 to assist with the payment of the Scientific Committee on Antarctic Research (SCAR) subscription which is by far the largest international union subscription to be met ($24,515) but, unfortunately they were unable to assist with any funding.

International Travel Assistance
Financial assistance totalling $18,250 has been provided to seven NZ delegates to attend their respective International General Assemblies or Congresses. These are listed in Appendix XI.

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

International Funding Assistance for Symposia/Workshops
Seed funding to symposia/workshops has amounted to $8,187.50. These are listed in Appendix XII.

International Visitors to the Society
The Society continues to liaise with overseas visitors using its own, as well as government resources. A full list of international visitors to the Society during the reporting period is attached as Appendix XIII.

3 Highlights

At the present time, seven eminent New Zealand researchers hold positions on international union committees or commissions. In particular, Professor David Parry, Massey University has recently been elected Vice-President of the Board of ICSU, a very senior and prestigious position.

A particular highlight was the visit to New Zealand by Robert Lord May, the President of the Royal Society of London.

Two Social Science researchers, Professor Lois Bryson (University of Melbourne) and Professor Sandra Nutley (St Andrews University, Scotland), were invited to New Zealand in July 2002 and they provided presentations at the Auckland, Wellington, and Palmerston North university campuses.

The Royal Society signed a Memorandum of Understanding on 23 November 2001 with the Korean Science and Engineering Foundation. The MoU allows both parties to promote scientific cooperation where there is sufficient mutual interest. The MoU expires on 30 June 2003.

4 Strategic Direction

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

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

MANAGEMENT OF THE SCIENCE AND TECHNOLOGY PROMOTION PROGRAMME

1 Overview

With the exception of the Communicators Programme, all of the activities funded by this Output and reported on below have now ended. Output Five has been reclaimed by the Ministry for the dialogue initiative.

The Royal Society is particularly keen to continue its Communicators Programme (formerly titled the Royal Society Role Models Programme), which is closely allied to the objectives of the dialogue initiative. This is now being funded under Output 6.

A lot of research has now being carried out into public attitudes to S&T, GM, methods of conducting dialogue, and the S&T Promotion Fund. This has provided a solid foundation upon which to *act* on the wealth of knowledge it provides.

In particular, we want to help scientists relate to the public, to inspire interest in and understanding of their work, whether this is through talks to small rural Probus groups, or a radio interview with Kim Hill. We are trying to put a human face to science and technology, and establish and promote our heroes, such as Alan MacDiarmid, Vaughan Jones and Maurice Wilkins.

Some of our ideas for the future are presented below under "Strategic Direction".

2 Progress and Achievements Evaluation

2.1 Royal Society Communicators Programme

Database

The database of over 120 Communicators – scientists who are willing to speak to the general public - has been used by the Royal Society to locate and provide speakers for Te Papa, The University of Auckland, and community groups throughout the country. This database is active and growing steadily, incorporating both young and enthusiastic members as well as experienced senior members of the scientific community.

Training workshops

The Society received 15 responses to its tender call to run a series of workshops to train scientists and technologists in media and communication skills. The successful tenderers were Jim Tully (HOD of the Department of Mass Communication and Journalism at the University of Canterbury) and Lee Wilkinson (Co-director of Communicate Consultants Ltd in Wellington). Together, they produced a comprehensive 4-day programme that included dealing effectively with the media, handling interviews, writing in plain English, building a relationship with an audience, and presentation skills.

The workshops were held on:

28-31 January, Science House, Turnbull St, Wellington
11-14 February, University of Canterbury Journalism School
8-11 April, Stardome Observatory, Auckland

Interest in the workshops was excellent, with applications far exceeding the available places. Employers (CRIs, Universities, and private institutions) were happy to distribute the advertisement

within their organisation, and grant successful applicants leave to participate in training workshops and present talks to general audiences. With the success of this programme, the Royal Society has planned three further workshops for Auckland, Palmerston North and Christchurch in late 2002/early 2003, using the funding surplus from the 2001-02 financial year. The format has been revised slightly to fit into 3 longer days, as many potential participants found it difficult to take 4 days off work.

Speaking programme

The Communicators speaking programme has been building steadily through the year and is active in Wellington, Palmerston North and Christchurch. The Otago Institute is commencing a speaking programme in Dunedin. Many organisations such as Rotary and Probus have their programmes planned well in advance with little chance of adding extra speakers. However, about 50 speaking engagements have already been arranged and most organisations have expressed great interest in booking Communicators at a later date. Many organisations that have had a Communicator to speak have contacted the Royal Society to arrange another engagement. Twenty-five Maori Communicators have been incorporated into the programme and are currently seeking dialogue opportunities within their own communities. Informed commentary on interactions already carried out show that this programme is an excellent vehicle for the Output Objective "activities that create an appreciation of the role of science and technology in developing a knowledge society in New Zealand".

Progress in Centres:
Wellington:
There have been approximately 40 interactions with the general public, including talks to Rotary, Lions and Probus Clubs, gardening groups, marae, scout troops, school classes and teachers. These have taken place throughout the greater Wellington region, including Wellington City, Lower Hutt, Upper Hutt, Porirua, Waikanae and Otaki. The Science and Health Weekend at Te Papa in November 2001 is reported on in the "Highlights" section.

Christchurch:
At least 20 speaking engagements have been booked with general interest groups. This programme is being run in collaboration with Canterbury University's Science Outreach Programme and the Canterbury Branch of the Royal Society.

Palmerston North:
"Science in the Plaza" attracted good audiences during the July school holidays. This outreach programme was run by Te Manawa (the Manawatu Museum and Science Centre).

The Manawatu Branch of the Royal Society is hosting a series of public lectures on topical issues in science and technology. Communicators have fulfilled several speaking engagements in the Manawatu region, including Palmerston North, Pahiatua and Levin.

Auckland:
The Auckland Branch of the Royal Society is planning an evening of education and entertainment for children – "Midnight at the Museum" - at Auckland Museum.

Nelson:
The Nelson Branch of the Royal Society has run two training workshops for local primary and intermediate schoolteachers. These workshops have included practical exercises and information aimed at boosting the participants' confidence in teaching science.

Science Communicators Network Meeting 22-23 November 2001

The workshop, held at Te Papa, attracted ninety-five participants from many S&T organisations including universities, science centres, medical schools and Crown Research Institutes. The workshop began with an address by Professor Paul Callaghan, President of the Royal Society Academy Council. He emphasised the human-interest aspects of science and their importance in engaging the public. Kate Smith, Strategic Planner for Saatchi and Saatchi talked about ways and means of getting people's attention in an information-crowded market. An afternoon was devoted to "Science in Society", looking at issues such as food scares, the Royal Commission on Genetic Modification, MoRST's policy on engaging the public, and some comments on the way Maori view science.

Mark Blumsky, former Mayor of Wellington, addressed the topic "selling shoes, cities and science". One of the key points he made was that the first step in "selling" science is to sell it to the scientists, who can then be enthusiastic and effective advocates. A further session kicked off with an address by Gary Lewis from Geosciences Australia, outlining their communication and education programmes.

Mark Sainsbury, Political Editor for TVNZ, chaired a session on media. Reporters from radio, print and television talked about the realities of news coverage, the competition science communicators face from other news sources, and practical hints for increasing science coverage.

"Wow! it's science" website

The "*Wow!* it's science" website finished another successful year of featuring topical issues, interesting careers and profiles of scientists. This website continues in existence but is no longer updated as government funding ceased after June 2002. The Royal Society plans to incorporate the site into the Royal Society site next year.

Research Reports

The Royal Society commissioned Karen Cronin to conduct a study on science communication. The research carried out involved a case study of the GE debate in the Kapiti District. Results show that the level of public understanding about GE is higher than may have been assumed in the past, and that the public are actively seeking information to become better informed and involved in the debate.

A research project by Fiona Cram, International Research Institute for Maori and Indigenous Education, The University of Auckland, examined Maori attitudes and awareness of science and technology. Three case studies have been researched, with the interactions between scientists and local iwi analysed for their effectiveness. Out of these case studies come several recommendations for ensuring that future communication between iwi and scientists are approached in a sensitive and appropriate manner.

A research project by Parker Duignan has been completed although a final report had not been received as at 17 October. Part 1 of the project reported on the issue of dialogue with the public and recommended how dialogue processes may be undertaken. Part 2 involved piloting the use of a community deliberation process on the issue of how society manages the risks and opportunities of science and technology.

3 Highlights

It was gratifying to observe the enthusiasm, serious commitment, and personal development of scientists who underwent presentation skills training via the Communicators Programme. These, in the main, younger people are very enthusiastic about getting out into the community and talking about their science and are prepared to conquer their nerves in this cause.

On 10-11 November 2001 the Royal Society, together with the Foundation for Research, Science and Technology, hosted a Science and Health Weekend at Te Papa. This was associated with the Body Odyssey exhibition. Science-related events throughout the museum included talks for all ages, a quiz for kids (with great prizes), a story-telling session and fossil digs where intrepid young explorers searched for fossils in the sandpit, identified them and took their specimens home. Several Communicators participated in this event (Shauna Sylvester, Kaa-Sandra Chee, Anthony Poole, Steve Broni, Craig Jones and Richard Hall). Approximately 500 people directly participated in the Science and Health Weekend events, with 8,325 visitors to Te Papa during the weekend.

At the Science Communicators' Workshop, the interaction of science communicators with people from Saatchi and Saatchi, high profile journalists, and promotion-savvy individuals like Mark Blumsky, was very stimulating and useful in connecting science with the "real world" of marketing, in which there is fierce competition for short public attention spans.

4 Strategic Direction

The Royal Society is committed to equipping scientists and technologists with the skills to communicate *directly* and effectively with all New Zealanders, and to creating more opportunities for them to do so. To that end, we plan to continue to develop the Communicators Programme as follows:

- Develop the programme in ways that meet the requirements of the new Dialogue Fund, yet to be announced. For example, the Royal Society might expand its training programme in the areas of facilitation and two-way dialogue. Through its comprehensive networks and membership, the Royal Society is in a very good position to support and promote the dialogue initiative.
- Continue with expansion of the Communicators Programme into Auckland and Upper North Island.
- Develop a programme of talks by our best speakers on topics which we know will attract large general audiences; co-opt local organisers but coordinate and promote centrally.
- Offer more training workshops for emerging scientists.
- Expand training programme to include intensive 1-day workshops on specific topics, e.g. advanced presentation skills, facilitating meetings, working with iwi.
- Develop the database of community, business and professional groups that regularly require speakers and send them information on the speakers and menu of topics available.
- Enlist more willing speakers, including graduates of the training courses, and experienced and able communicators (Teacher Fellows, S&T Medal winners, James Cook Research Fellows, Companions and Fellows of the Royal Society, etc.).
- Establish some form of recognition and incentive for this voluntary/extra-curricular work.
- Involve other organisations as partners, eg. Royal Society Branches, Universities, science centres, CRIs, Carter Observatory.

Extending the programme to the media
For the last 18 months, the Royal Society has invested considerable staff resources in promoting science via the media and has been very successful in doing so.

For example, since March 2001, at least 15 New Zealand scientists have been interviewed at length on the National Programme (usually Kim Hill), including Maurice Wilkins, Vaughan Jones, Alan MacDiarmid, Diana Martin, David Penny, Jeff Tallon, Ian Hall, and George Petersen. We regard radio interviews as especially valuable, because the scientist is able to talk directly to the listener and the personality and passion shines through. As a result of our work, the coverage of science has increased significantly. Such media promotion is extremely cost-effective and the Royal Society is uniquely placed to do it. About one third of the press coverage on S&T is generated directly or indirectly by Royal Society activity.

This work is closely related to the goals of the Communicators programme and, of course, reaches much larger audiences. Up to 300,000 New Zealanders may hear an interview by Kim Hill. We recommend that the Ministry fund this work as part of a programme to take science to the community and to put a human face (and voice) to science. There are limitations on the number of New Zealanders we can reach through face-to-face communication. Radio, particularly, is a way of having satisfying public dialogue, through an interviewer.

Visits by international scientists are an important way of generating discussion about S&T at public forums and via the media. The national tours by Alan MacDiarmid and Robert May in July 2002 and March 2003 are two notable examples. We regard these as a most effective way of promoting S&T to the general public and informing them on science issues. Such visits are a natural extension of the Communicators Programme, which we see encompassing a range of communications, from a PhD student talking to a group of gardeners about the nocturnal habits of hedgehogs to a Nobel Prize winner addressing business people and VIPs about the importance of R&D.

5 Funding Support and Execution

The dialogue initiative is an important contribution to New Zealand's future development. However, it supports rather than obviates the need for an active science and technology promotion and awareness programme.

It is hoped that an extended Communicators Programme, encompassing media promotion and supporting visits by international scientists, will be funded through Output Six.

CONTESTABLE FUND FOR SCIENCE AND TECHNOLOGY PROMOTION

1 Overview

Twelve contracts were awarded funding from the Science and Technology Promotion Fund for the 2001-02 year. The Terms of Reference specify that the principal objective of this fund is to promote positive values and attitudes towards science and technology at all levels in the New Zealand community. In particular, projects aimed at audiences not normally interested in science and technology, projects that effect an increase in positive attitudes towards science and technology, and projects that promote the value of science and technology in exciting and innovative ways, receive priority for funding. The projects awarded funding for 2001-02 fulfil these objectives.

All projects are either complete or are nearing completion, with the exception of 2-year programmes 'Sounds Fun' and 'A Journey of Discovery Board Game'. 'A Minute of Science', the project awarded the $100k category, has aired on TVNZ's 'Knowledge Breakfast' series, but has experienced broadcast delays in other slots owing to major sponsors unexpectedly withdrawing their support.

As already mentioned, the fund has been comprehensively reviewed and the recommendations implemented this year. Past applicants generally regarded the Royal Society as a good administrator. However, the large number of applications inevitably leads to much disappointment and some cynicism. Six to seven times the amount of money available is requested, the disparity increasing greatly this year.

2 Progress and Achievements Evaluation

Sixty-eight applications were received for the 2001/02 Promotion Fund with a total of $2,374,380.00 requests for the $400k available, 59 were for the "under $30k" category and nine for the "up to $100k" category. Of those 68 applications, 12 were successful, 11 for the "under $30k" category and 1 for the "up to $100k".

See Appendix XIV for list of 2001-02 recipients and progress to date.

3 Highlights

Noteworthy completed contracts include a very successful science and technology hui in Dunedin for over 200 Otago-based Maori of all ages, a series of very popular earth science workshops for South Island secondary school teachers, and a professional street theatre production in South Auckland that attracted hundreds of spectators at each performance.

4 Strategic Direction

Review of Contestable S&T Promotion Fund

The Royal Society conducted a review of the fund and commissioned an independent contractor to interview previous applicants about its purpose and operation. A full report with specific recommendations was provided to the Ministry by the agreed deadline.

The main changes recommended following this review were to:

- have a two-step application process, to make the selection process more efficient and less time-consuming for applicants.
- remove the arbitrary $30k limit, which may have encouraged applicants to inflate budgets, and on the other hand created barriers for projects costing over that sum.

All the recommended changes in the report have been successfully implemented in this year's round.

The fund is supporting some very worthwhile projects and is extremely competitive. Unfortunately, the stiff competition is leading to some bitter disappointments and hard feelings. Many very good projects miss out and their enthusiastic proponents find it hard to accept. Instead of serving as a morale booster for the promotion sector, the fund is in danger of having a demoralising effect. Some of these individuals and organisations may not bother to apply in future.

The fund has remained static in dollar terms. We believe that the results are sufficiently convincing, and the stimulus to the S&T promotion community so worthwhile, that a substantial increase from $400k to $600k should be considered. This would also serve to increase the investment from non-government sources. Most projects contribute volunteer labour and their own cash and other resources. This makes the fund a good investment of taxpayer dollars.

Initial indications from the 2002/03 round are that the new two-stage application process is a success. The removal of the $30k limit has resulted in a wider range of amounts requested, with many around $50-70k. However, this more accurate costing of projects has resulted in a smaller number of projects being funded than previously.

Royal Society Communicators Programme
See comments in the previous section. Since June 2002 and the demise of Output Five, this programme has been funded under Output Six, although the amount available in this Output was not increased.

We have been explicit about the way in which we intend to expand the Programme, encompassing our present very successful media promotion activity and visits by international scientists. We also intend to adapt and extend our training programmes for scientists to meet the objectives of the government's dialogue initiatives, eg facilitation courses.

The Royal Society has an excellent national network of our top scientists and science communicators. It is in a good position to enlist willing speakers and put people forward for radio and television interviews.

FOSTERING TALENTED YOUNG NEW ZEALANDERS

1 Overview

Purpose and objectives
This activity by the Royal Society includes projects and activities contracted by the Ministry of Research Science and Technology as well as other activity carried out under sponsorship, such as science and technology fairs, BP Challenge etc, or *via* relationships with NZ Association of Science Educators (NZASE), Technology Education NZ (TENZ) and other professional teacher associations. The projects and activities promote the value of research, science and technology as being critical to future prosperity, and of science as having cultural value in its own right.

The activities contracted by MoRST are to:
- Develop a database of young achievers in science and technology, enabling tracking, information, support and encouragement.
- Develop a database of people with science and technology experience who are prepared to do volunteer work with young people to support and grow their interest in science and technology.
- Administrative support for students and teachers taking part in science and technology programmes outside New Zealand.
- Planning of a national event (*Realise the Dream*) to celebrate and recognize achievement in scientific or technological practice by school students.

The databases enable the Society to maintain communication and support for young people and teachers by informing them of recent developments and innovations in scientific and technological practice, opportunities for their benefit such as scholarships and competitions, and to identify potential mentor relationships with practitioners in the science and technology communities. The international activities expose many of our promising young scientists and technologists to latest research and new knowledge as well as allowing them to establish friendships with foreign students of similar interests. Opportunities for future collaboration are generated through involvement in actual research projects, and the value of science and technology is demonstrated to these young New Zealanders. In addition, our promising young people are exposed to different social cultures and gain a perspective of New Zealand's place in the world. The database will also enable us to keep track of these young people and evaluate the contribution of these programmes in the future to their careers and development. While this activity falls within the Promotion of Science and Technology Output Class, it could well be considered appropriate to the Supporting Promising Individuals output class as it contributes to

supporting human resources in research, science, and technology and contributes to the development of people with knowledge, skills and ideas, albeit to a different age group than traditionally encompassed by the SPI Output Class. This report will demonstrate the contribution made in terms of educating young people, increasing their awareness of new knowledge and innovative practice, and exposing them to different cultures.

The essence of what made the science school so enjoyable was not solely the scientific content but the balance of this content with social interactions. I have made friends for life.

Jashneel Agravaal, Manurewa High School

The Society is grateful for the support provided by other organisations, particularly Asia2000, BRANZ and the British Council, which enables the cost to students to be minimised.

2 Progress and achievements evaluation

Scope and scale

The database currently holds 651 young people from the ages of 6 – 24 years old who have shown high level of interest or achievement in science and technology - 90 at primary level, 256 at secondary and 305 at tertiary level. These have been drawn from programmes such as the Knowledge Wave conference, Genesis Science Forum Science and Technology Fairs, CREST, and subject association competitions. The database is continually added to as we learn of other young achievers from other programmes. Information such as academic achievements and their future aspirations have been gathered from the students.

The Society writes and sends six-weekly electronic newsletters to the students to keep them informed of scientific/technological news, scholarships and opportunities for them to attend various functions. An informal survey of opinion on NCEA was carried out with Year 11 pupils, with general acceptance of NCEA by those who responded.

The Society's support of the CREST Award scheme and Technology Education NZ provides the basis for the database of adults. The major outcome from this database is the establishment of linkages/mentoring relationships between practitioners and pupils based on an investigation or piece of technological practice by the young person. The Society's good working relationship with institutions such as the Institution of Professional Engineers (IPENZ) and NZ Institute of Architects (NZIA) powerfully supplement this activity.

The Royal Society currently administers selection of student/teacher participation for the:

- Singapore Science Research School
- Nanyang Technology and Engineering Research Programme (Singapore)
- US International Space Camp
- Australian International Space School
- Monbusho Science School (Japan)
- Prof Harry Messels' Science School (Australia) (biennial)
- Taiwan Science Fair
- APEC Youth Science Festival (biennial)
- Hong Kong Science Fair (new for 2002)

In the 2001 school year, 16 pupils and 3 teachers have been supported to take part in international events (Science Fairs, Science Forum/Congresses, and Space Camps) in 5 countries (Australia, Hong Kong, USA, UK and Malaysia).

We have also selected students and teachers to display at the Malaysian Invention and Design Expo in the past, but this event has not taken place in the past two years. We were disappointed to learn that the Singapore Government had decided not to support international participation at the Singapore Science Research School and Nanyang Technology and Engineering Research Programme in 2002 as well.

An agreement has recently been reached with the Beijing Association for Science and Technology for reciprocal participation in science fairs; New Zealand will be represented at the Beijing Fair next year. Negotiations are also taking place with the Shanghai Association for Science and Technology which will see a similar arrangement.

Applications are called for nationally and selections made by independent panels. The Royal Society carries out the administration of each and assists in the gaining of financial sponsorship for some. The Society is grateful for the support provided by other organisations, particularly Asia2000 for programmes in Asia, Genesis Energy for support of the travel to the Taiwan and Hong Kong science fairs, and BRANZ and the British Council for support of the London International Youth Science Forum. This support enables the cost to students to be minimised. The selected participants pay for all costs for the other events – the US International Space Camp, Australian International Space School and Prof Harry Messels' Science School.

Participation in the Australian International Space School was reviewed by the Society in 2000 because of concern over the educational benefits of its programme. A Royal Society staff member accompanied the delegation this year and has made recommendations regarding the programme. The Australian organizers appreciated this input, and we will be working much more closely with them in preparation for next year's programme, and ensuring that our recommendations are adopted.

Planning for *Realise the Dream* is progressing well. The programme has been outlined to include celebration and recognition for up to 50 of our young achievers in scientific or technological practice as well as furthering their knowledge, understanding and skills and broadening their horizons into areas of the commercial development of their ideas and innovations. Organisations consulted with, including teacher associations, tertiary institutions, CRIs and R&D based industry, as well as those such as the Intellectual Property Office, have shown strong support for the concept. Sponsorship is currently being sought.

3 Highlights

The appreciation of the monitoring and tracking of young achievers by the young people themselves was extremely rewarding.

Significant media coverage, particularly in community newspapers but also on radio and television, generally news or the TV One Holmes Show, is achieved by the selection of these students, further promoting to the NZ public the value of science and technology and the opportunities available. Highlight for this year would be the appearance twice on the Holmes Show by Andrew Brown of Dunedin who attended the US Space Camp.

Highlights of these activities are captured by comments from participants:
I learnt a great deal while I was there, not just about what we were studying. I learnt also about the nature of conducting professional research, and came to understand different cultures. I now have a much clearer idea about my future in research.

Alia Reid, NanYang Technology and Engineering Research Programme

I was enlightened by the possibilities for me in the future and even though I had previously not been set on doing biology, it is something that I am so interested in now. It was a trip of a lifetime and one that I will never forget.

Sarah Handley, Singapore Science Research School

Gaining sufficient sponsorship from the Building Research Association to enable assistance with travel costs to the London International Youth Science Forum was a major achievement and has resulted in this opportunity being available to young people of any background. This caused a 600% increase in the number of applications for this award.

Comments received from those on the database express support and gratitude for this concept far better than we can write:

Wow, this is an excellent newsletter Debbie :-)

Christo Fogelberg, 2nd year computer science degree at Otago

Thanks to the Royal Society for its effort in the promotions of science and technology through the database and newsletters. I had great fun in participating in some of the programmes you manage.

Kevin Huang (yr13 student) Rangitoto College Silver CREST

Thanks for the newsletter. It's thanks to opportunities sponsored by organisations such as the Royal Society that open up horizons and create paths that lead to amazing experiences and learning possibilities.

Tana Wuliji, Otago Uni 4th year pharmacy student

4 Strategic Direction

The reception that this activity has had with young people and the benefits from the international participation indicate that it is highly valuable and beneficial and that it must be continued and strengthened in the future. The new national event, *Realise the Dream,* for celebrating and fostering young achievers across the broad arenas of sciences, mathematics, social sciences and technology that is being planned within the 2002-03 Output Agreement will assist with this. Our intentions are to provide, via private sector sponsorship at this event, further opportunities for our young high achievers to interact with those of like mind in international settings.

We would also like to be able to offer assistance with travel costs to those existing international opportunities for which we have not yet found private support. The increase in the number of applications for the London Forum clearly demonstrates the inhibiting influence of travel costs.

It is imperative that we fully and proudly recognize the achievements of our young minds, encourage and support them, and use them in return. We would like to build towards a concept such as the Minister's Young Ambassadors for Science and Technology – a group of up to 20 young people who excel in scientific investigation or technological practice. Such a group could be given training in communication (linked with the current Communicator's Programme managed by the Royal Society), profiled as role models, and even offer opinion on RS&T issues to the Minister. This concept will be developed further as plans for *Realise the Dream* develop. The financial support required would be covered by a continuation of the $30k provided this financial year for the development of *Realise the Dream*.

Many activities which promote the value of science and technology take place within schools as they also enable students to develop knowledge and the skills of innovation and investigation. Such activities are implemented on a voluntary basis by teachers and others, and are reliant on goodwill and/or sponsorship for their survival, and so it is not surprising that the benefits are sometimes not as great as they could be. It is within this output that there is the opportunity to identify worthwhile activities and programmes and provide management in a collective manner (CREST, Olympiads, Science and Technology Fairs, Future Problem-Solvers, Young Investigators, etc) rather than forcing each to compete and eke out existence. In this fashion, leverage is gained for opportunities to promote the value of research, science and technology as being critical to future prosperity, and of science as having cultural value in its own right.

It certainly widened my viewpoint and career options, and it was exciting gaining a first-hand experience on current break-throughs in the field of science and technology. I made many friends who I hope to keep in contact with.

Heather Murray, Prof Harry Messel's Science School

It must be accepted that investments in these areas are long-term and meaningful measurable benefits will not be seen in a 12 month period. This is one aspect that the maintenance and use of the database will allow.

Selection for the international activities is becoming more strongly contested amongst students and teachers. Previous participants have reported significant impact on their enthusiasm for science and technology, a much greater awareness of the benefits of science and technology, a much greater awareness and appreciation of cultural differences, increased knowledge and greater awareness of potential careers.

The Professor Harry Messel International Science School was the most exciting and valuable experience of my life and fond memories of the time I spent there will remain with me forever.

Kirsten McSweeney, Prof Harry Messel's Science School

The AISS gave me the opportunity to learn and explore more of space using Australian facilities. I now have a better idea of what job opportunities there are in the aerospace area. I enjoyed every day of my trip and miss every other member that attended with me.

Edward Lau, Australian International Space School

NEW ZEALAND SCIENCE AND TECHNOLOGY MEDALS

1 Overview

Rutherford Medal
The Rutherford Medal is the highest award instituted by the Royal Society of New Zealand at the request of the Government to recognise and honour those who have made exceptional contributions to New Zealand society and culture through activities in the broad fields of science, mathematics, social science, and technology.

The Rutherford Medal recognises a significant contribution to the advancement and promotion of public awareness, knowledge and understanding in addition to eminent research or technological practice by a person or group in any field of science, mathematics, social science, or technology. A group award shall only be made in very meritorious circumstances.

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

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

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

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

2 Highlights

In 2001, one Rutherford, six Silver and 20 Bronze medals were awarded.

The 2001 Rutherford Medal was awarded to Professor Peter Gluckman by Lord May, the President of the Royal Society of London at a ceremony at Old Government House in Auckland on 4 March 2002. The 2001 Silver and Bronze medals have been presented at various local ceremonies around the country during the last year.

3 Strategic Direction

Pickering Medal
At a recent meeting of the Royal Society Council, the President reported that he had met with Sir William Pickering who had agreed to the use of his name for a Royal Society medal rewarding excellence in technology. He had also spoken with the Minister, Pete Hodgson who was supportive of introducing such a medal.

The Council agreed that this medal would have the status of the Rutherford Medal and it was suggested that the Pickering Medal could be added to the New Zealand Science and Technology suite of medals. If MoRST agreed to this, then the Rutherford Medal would be awarded for excellence in science alone, not science and technology.

4 Funding Support and Execution

We recommend that the Ministry considers adding a Pickering Medal to the suite of New Zealand Science and Technology Medals, and increase funding of the medals by an initial $8k to cover the cost of striking the medal, and $5k annually to cover the costs relating to holding an award ceremony and Royal Society administration costs.

SCIENCE AND TECHNOLOGY PUBLICATIONS

1 Overview

The Royal Society, through its publishing unit (RSNZ Publishing), synthesises, documents, and disseminates the results of New Zealand research, in seven internationally recognised refereed scientific journals and other types of publication in printed and/or electronic form, to the benefit of others and to complete the investment made in the research.

The market for the science journals is global and related to worldwide investment in science and technology. As the value of the "knowledge economy" continues to grow, there is reason to believe that the market is also likely to grow in those countries which are investing in science and technology.

Journal users are generally broken into Institutional and Individual subscribers. Traditionally, the Individual market is strongest within New Zealand, and Institutional markets are strongest overseas (especially North America). Within these sub-markets are others relating to geographic area of sales (United States, United Kingdom, Australia/Asia, New Zealand), discipline (subject), and regional scope of the individual journals: *New Zealand Journal of Marine and Freshwater Research*, *New Zealand Journal of Geology and Geophysics*, *New Zealand Journal of Zoology*, and *Journal of the Royal Society of New Zealand* focus on the Australasian, Pacific and Antarctic regions; *New Zealand Journal of Botany* is relevant to Pacific and Southern Hemisphere regions; *New Zealand Journal of Agricultural Research* is relevant to temperate and subtropical regions; *New Zealand Journal of Crop and Horticultural Science* is relevant to crop and horticultural science worldwide.

2 Progress and Achievements Evaluation

There are three main areas of the publishing operation which are currently being developed (see Strategic Direction below): electronic publishing; journal performance; and business processes. Progress in these areas over the last year is itemised below:

Electronic publishing

- Promotion of the journals via the Royal Society website is ongoing. The new website presently being developed will place greater emphasis on the journals and their availability online.
- Journal abstracts are routinely mounted on the web with the publication of each journal issue. Current abstracts are available back to 1994
- An Early Alerting System for those interested in receiving email notification of journal publication and availability of abstracts has begun for all the journals published in 2002. This will be ongoing for all future journal issues published.
- PDF files of all journals published in 2002 have been made available on the web at no cost. Online publication of the journals will be routine on a subscription basis as from 2003. Online publication happens weeks ahead of the printed journal, thereby bringing times to publication of the journals forward.
- Online publishing will benefit New Zealand science by improving the immediacy, cost, and access of publication of local research and also enlarge the potential readership and citation of that work, thereby enhancing its reputation internationally.

Journal performance

- Six of the seven journals now have Editorial Advisory Boards, and many of these have met to formulate strategies for future development of their journals.
- The Advisory Boards provide status and a mark of quality for the journals.
- Strategic plans for the journals are presently underway between editors and their Advisory Boards.
- Surveys of the scientific community ensure that the journals are meeting the needs of their users. Surveys have been performed for *New Zealand Journal of Crop and Horticultural Science* and *New Zealand Journal of Marine and Freshwater Research,* and their results collated.
- We continually review our editorial procedures and performance criteria to improve their efficiency and effectiveness.
- Marketing and promotion are ongoing activities performed by the editors and increasingly by members of the Advisory Boards through personal contact, visiting institutions, and by distributing printed flyers.
- Our database is constantly being updated with a wide range of international and national journal reviewers.
- Our initiatives in electronic publishing (online journals and abstracts, Early Alert, website upgrades) are together increasing the awareness and performance of the journals.

Business processes

- To enhance our manuscript handling procedures and speed up manuscript assessment and publication times, we are moving to a system of electronic submission and review. This will also result in decreased postal costs, especially of manuscripts to overseas reviewers.

3 Highlights

- Inaugural meetings were held of the Editorial Advisory Boards of the following journals: *NZ Journal of Agricultural Research*; *NZ Journal of Botany*; *NZ Journal of Crop and Horticultural Science*; *Journal of the Royal Society of NZ.* The boards will be instrumental in formulating strategies for future planning for the journals.
- Opinion surveys of users of *NZ Journal of Crop and Horticultural Research* and *NZ Journal of Marine and Freshwater Research* were carried out and summarised. Results of these surveys will provide invaluable information for inclusion in the journal strategic plans.
- Online publication of all journals was begun in 2002.
- An emailed Early Alert for users of the journals, informing them of the imminent publication of their journal and its contents, was instigated to be sent routinely with every issue of all journals published.
- The *Journal of the Royal Society of NZ* was ranked 9th out of 45 other multidisciplinary journals in 2001 by the Science Citation Index, with an impact factor of 1.423.

4 Strategic Direction

The goal of Royal Society Publishing is to promote New Zealand's science and technology to the New Zealand and international scientific community, and facilitate the sharing and using of new knowledge, through the publication and dissemination of printed and/or electronic, high-quality, refereed research journals and other types of publication. The Publishing Business Plan for 2002-2003 called for three new additions to its operations to enhance the effectiveness of the journals and improve their performance and status, namely. (1) the introduction of electronic journal publication; (2) improving journal performance through the establishment of Editorial Advisory Boards, and increased activity in marketing and promotion; and (3) streamlining processes for the electronic management of papers submitted for publication. Steps taken to date, as outlined above, indicate the extent to which current strategies have been implemented. Further development of the electronic processes for the submission and reviewing of manuscripts is required to complete this objective of the strategic plan. In addition, strategic plans for all journals will be formulated to set the direction for their future development, both individually and as a whole. The formation of the Advisory Board for the *NZ Journal of Zoology* will complete the objective of having boards for all journals.

5 Funding Support and Execution

In the last 10 years that the journals have been published by the Royal Society, they have been supported by ministerial funding of around $350k a year, without increase, and with no allowance for the 33% inflation over that period. During that time, journal publishing worldwide has been experiencing a revolution in science publishing on the internet, which has been one of the main contributing factors leading to severe reductions in library subscriptions for the printed journal. This has been particularly difficult for regional journals, such as the New Zealand journals, which normally have a limited subscriber base because of the limited regional market. The resultant reduction in income has been managed in the past by:
(1) moderate subscription increases; (2) imposition of a nominal page charge for non-subscribing authors; and (3) the concurrent reduction in production costs made possible by changing to computerised desktop publishing methods at an early stage, and other technological advances in the printing process. Also, drastic reductions in personnel have reduced costs internally but led to a situation where staff are now overloaded and their output is affected.

The Society has recently put processes in place to attempt to eliminate the budgetary shortfall predicted for 2003.

- In June 2002, Council made an additional $30k of Society funds available for part-time contract editing of *NZ Journal of Agricultural Research* to continue for another year. This is a temporary measure to enable our immediate future publishing obligations to be fulfilled.
- Editorial Advisory Boards for the journals have been established to help determine their future needs and how those needs might be met. Individual strategic plans are being produced from which a further business review of journal publishing *in toto* can be produced.
- In addition to seeking extra funding, the Royal Society Publishing unit is looking to raise its income by increasing subscription rates in 2003 (by 15% for online journals plus an additional 20% for print+online). Also, the current page charge of $50 per printed page, payable by the author upon publication of a paper, will become compulsory when the present alternative option to subscribe to the journals will be removed. Finally, the discount to subscription agents will be reduced from 5% to 3%.

The imposition of page charges is anticipated to result in significant resistance from authors in the short term. However, with the advent of online publication of the journals, research results will become "freely" available to a much larger group of users at proportionately less cost. Thus, the cost of publishing the research will shift over time from the user to the provider, such that the real cost of publishing will be regarded as part of the cost of the research itself.

Immediate funding requirements
(1) Additional funding for 2003/04 of at least $30k is a prerequisite for the journal publishing programme to continue under status quo conditions.

(2) In addition, we are looking for our annual funding to be restored to its pre-inflationary value (ie. from $350k to $465k, an increase of $115k pa) to allow us to increase our editorial and production resources to their preferred operational level.
(3) Further new funding of $140k (one-off payment) would allow us to convert the national journal archives to a digital platform, with attendant ongoing annual costs of up to $20k for possible website development and administration.

Total new funding sought for 2003/04 is $125k, plus one-off investment of $140k for development of digital archives – please refer to Appendix XV "RSNZ Publishing – *a case for the national research journals*".

Alpha and Gamma series

1 Overview

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

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

The **Gamma** resource gives a balanced and factual account of the science behind scientific issues in the news. While it is primarily designed to support the learning of science and technology in the school curriculum, it too is appropriate for the general public. Many public libraries subscribe to the series, and particular issues have been made available to journalists and other groups in the community.

Scope and scale
Four issues of Alpha and five of Gamma are produced each calendar year. In 2001, the following were published

Alpha
Marine Biodiversity
Tourism and the environment
Oil and Gas
Helen is a seismologist

Gamma
Genetic Engineering and ethics
Foot and Mouth disease
The promise of stem cell research
How now mad cow
Food labelling

2 Progress and Achievements Evaluation

The production of the Alpha series has moved from a pre-1990 programme of 6-8 issues per annum as the public information series of the DSIR through a period of erratic, *ad hoc* production to a planned regular programme over the period 1996/1997 due to the employment of a staff member with dedicated responsibility. Credibility with schools has been re-established over the past 2-3 years both in terms of supply and curriculum linkage. A set of pupil worksheets, activities and further information is also provided to schools with the Alpha, and these have proved invaluable as well as providing educational credibility.

The Gamma series, initiated in 1996, has maintained publication of information on issues of relevance to New Zealanders.

3 Strategic Direction

Both series provide a valuable public information service and have at times been requested by public libraries or provided to politicians, government agencies or other organizations. It would be beneficial to be able to provide both series free to the public and select groups, but financial considerations prevent this. As a first step, the Gamma series will be available on the Royal Society website from the beginning of next year and the response to this will be monitored.

4 Funding Support and Execution

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

OPERATING PRINCIPLES

Focusing on results that benefit New Zealand

All funds administered by the Royal Society focus on results that benefit New Zealand. In particular, the *Marsden Fund* supports excellent research that enlarges the boundaries of knowledge and develops researchers with knowledge, skills, and ideas. The Marsden Fund achievements and indicators (Section 2 and Appendix II) and highlights (Section 3) testify to its success in accomplishing this.

Enthusiastic, passionate and inspirational teachers are critical to successful learning by children. The *Teacher Fellowship* scheme gives a small number of teachers the opportunity to rekindle their interests and passions, and to bring these back to colleagues and pupils. There can be little that benefits the future of New Zealand more.

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

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

The *Science and Technology Promotion* work establishes a culture of pride in achievements and is an immense benefit to New Zealand while the affirmation provided to our young achievers through the promotion activities encourages them to strive for greater achievement and ultimate contribution to New Zealand and its future.

Collaborating with other agencies

Relationships with MoRST, FRST, HRC, Industry New Zealand, Ministry of Education, NZVCC, ACRI, MFAT, MAF, CRIs, RAs, Universities, the British Council, Fulbright Foundation, a number of private firms, and Embassies and Consulates are maintained on an ongoing basis.

FRST and HRC are provided with a list of people involved in the successful proposals from funding rounds, to ensure that the researchers are not being funded by different funding agencies for the same work.

The Royal Society, FRST and HRC have worked together on a survey of postdoctoral fellows and postgraduate scholars, for which a summary of the analysis pertinent to the *Marsden Fund* is given in Appendix I. Discussion of the survey design and analysis has fostered a closer relationship between the people conducting evaluation in the Royal Society and in FRST and HRC. Monthly evaluation meetings with evaluators from MoRST, FRST, Royal Society and HRC are now being held, in which the agencies update one-another on the evaluation that they are doing. All four agencies have been cooperating on purchasing and analysing bibliometric data, as a means of assessing research quality.

The Royal Society also contributes to meetings on specific issues related to research, called by government departments and the other purchase agents. For example, the Society has attended meetings on climate change at MAF and health infrastructure with HRC.

The Royal Society develops and strengthens links between providers especially CRIs and universities through the *Teacher Fellowship* programme, particularly at the individual and operational levels. External organisations involved are the professional teacher organisations (in sciences, maths, social sciences and technology), research institutions, universities, polytechnics, and enterprises such as industries, local government, art galleries, zoos and science centres in terms of promotion of the programme and selection and hosting *Teacher Fellows*.

Funding of the *Teacher Fellowship* scheme is now contributed to by Ministry for Research Science and Technology and Ministry for Economic Development. As a number of *Teacher Fellowships* are engaged in work in the environmental science and environmental education areas, it may be considered appropriate for Ministry for the Environment to also contribute in the future.

Meeting current and future capability needs
In a *Marsden Fund* survey conducted in 2001 (and summarised in the 2001 PAR), 59% of principal investigators replied that *Marsden Fund* funding had increased, or was anticipated to increase, their groups' capabilities in the long term. Since the *Marsden Fund* purchases investigator-initiated research that increased capability is in areas chosen by the researchers themselves. In the same survey, a question on the influence of *Marsden Fund* funding on careers led to 8% of the principal investigators volunteering the response that the funding is a significant factor in researchers being retained in, or attracted to, New Zealand.

The terms of reference for the *Marsden Fund* state that one of the criteria by which proposals are judged is "contribution to development or broadening of research skills in New Zealand, particularly those of emerging researchers." The implementation of this, without any compromise on excellence, has led to strong support from the fund for female and emerging researchers. The introduction of the Fast-Start programme has not only supported emerging researchers, but may turn out to be a means of boosting the percentage of women researchers as well. In 2001, 7 of the 20 principal investigators (35%) on Fast-Start projects were women; this compares with 23% of the principal investigators on standard *Marsden Fund* contracts being women.

The *James Cook Research Fellows* generate new knowledge and expand New Zealand's scientific and technological capabilities. Evaluation has shown that *James Cook Research Fellowships* have a positive impact on the training and career progression of Fellows' staff and students, and in some cases fellowships have paved the way to the opening of collaborative institutions that in future will have a significant impact on New Zealand's research capability.

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

Purchasing balanced portfolios of research within output classes
Marsden Fund funding between areas represented by the eight panels is decided broadly by the number of quality proposals in that area. The assessment process explicitly considers the development of skills in New Zealand, particularly those of emerging researchers. The *Marsden Fund* Council has a goal of having a balance of proposals in which the risk of research success ranges from high to low.

These competing pressures – different research areas, the development of skills, and the risks associated with novel, cutting-edge research – determine the final range of projects in the *Marsden Fund*.

Teacher Fellowships demonstrate balance over learning areas (disciplines/subjects), gender, geographic and socio-economic factors. The under-representation of Maori and primary school teachers is being addressed and slowly being redressed. While there may be fluctuations in representation in any particular year in any aspect, over time a balance is maintained.

Running robust and transparent processes
All funds administered by the Royal Society have independent external panels for the different funds and awards and a clear, open selection process is used. Rigorous procedures are in place for avoiding conflicts of interest. Selection criteria are well advertised and Society staff provide reasons for decisions on request.

Marsden Fund preliminary proposals are assessed by eight panels of experts. Panellists, chosen for their particular field of expertise, are drawn from a range of institutions and geographical areas. About one-third of the approximately 60 panellists are replaced each year. The same panellists assess full proposals after review by three or more expert referees. At least one of the referees for each proposal is not nominated by the applicant. At the end of the funding round, the panellists, many of whom also

have experience of participating in reviewing applications for international funding agencies, are asked to suggest improvements to the process.

The *Marsden Fund* does not seek specifically to maintain the research capabilities in existing providers. The fund is available to all New Zealand based researchers who are judged on 3 key criteria – merit of the proposal, potential of the researchers to contribute to the advancement of knowledge, and contribution to development or broadening of research skills in New Zealand, particularly those of emerging researchers.

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

With *Teacher Fellows* four panels of representatives of all stakeholders (hosts, teachers, teacher educators, teacher professional associations and tertiary education institutions) are convened to make selection recommendations to a final panel comprising the chair of each panel plus the Education Electoral College Royal Society Council member.

Meeting quality standards
The Royal Society ensures that standards of merit are maintained. The *Marsden Fund* has proposals assessed by national and international experts. In the 2001 funding round, 83% of the referees were from countries outside New Zealand, ensuring that the proposals are meeting international standards.

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

Involving users and providers in strategy development
The Royal Society selection panels provide advice on the process and on the broader investment strategies.

In the case of the *Marsden Fund,* its Council decides the investment strategy. The latest initiative has been the Fast-Start programme for emerging researchers. The *Marsden Fund* maintains excellent relationships with providers, with a good flow of information both ways on criteria for selecting contracts and ways of improving the effectiveness of the investment. A strength of the fund is the direct contact of the *Marsden Fund* secretariat with the researchers, particularly through the monitoring visits. These visits, which sometimes include a member of the Marsden Fund Council, provide an opportunity for researchers to inform the fund of issues affecting their performance.

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

Funding the full costs of RS&T
All funds the Royal Society administers meet the full cost of contracted research.

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

Teacher Fellowships are accorded prestigious award status by the Ministry of Education, and so teachers are granted leave on full pay. Schools are awarded full costs for replacement of the Teacher Fellow. Host institutions may claim expenses towards hosting a Teacher Fellow.

Responsiveness to Maori

All Royal Society panellists are aware of the importance to respond to Maori.

2.2% of principal and associate investigators on *Marsden Fund* funded contracts are Maori, and Maori are involved in 5% of the contracts in 2001/02. Redressing this low participation in the fund by Maori will require comprehensive long-term policies beyond the *Marsden Fund*.

However, the *Marsden Fund* does receive excellent proposals from Maori researchers and on topics of immediate relevance to Maori. Currently funded projects of immediate relevance to Maori, of which there are twelve, include studies of the following:

- early settlement in New Zealand
- transformations in Northern Maori Society, c1200-1850 AD
- food sources and agricultural practices in prehistoric Maori settlements
- management and care of taonga held in museums
- Maori use of wetlands
- social, cultural, political, and practical aspects of Ta Moko
- a social history and content analysis of the Maori language newspapers, 1840-1950s
- the languages of South Auckland
- the theory and practice of Maori representation
- the link between bacterial immunity and cancer susceptibility relating to particular Maori families who are susceptible to stomach cancer

Some of these programmes provide active training in research for Maori students. In addition other programmes involve Maori researchers as principal or associate investigators.

In the 2001/02 year 2.9% of the total funding will go to programmes covering issues of specific interest to Maori and a further 2.8% on additional research programmes involving Maori as principal of associate investigators. That is, 5.7% of the funding is related to Maori either through the research topic or through enhancement of research experience and training. Whereas 2000/01 had seen the *Marsden Fund* seek to publicise the *Marsden Fund* to Maori, this year has seen an emphasis on publicising the research relating to Maori. This has been pursued through written media, radio and the *Marsden Fund* newsletter.

The Chief Executive and senior staff members represented the Royal Society at five hui-a-rohe, *Supporting Matauranga Maori and Innovation through Research, Science and Technology*, organised by MoRST and held in mid-2002. This provided the Society with the opportunity to publicise its programmes. More importantly, it exposed the Society to Maori and iwi perspectives.

With regard to the *James Cook Research Fellowships* in the 2001-02 round, the research of 5 of the 8 applicants' research in the physical sciences was considered likely to benefit Maori and to make a significant advance in Maori knowledge. The research of 2 out of 8 in the Biological Sciences was considered likely to benefit Maori, and the research of 8 out of 13 applicants in the "Research of Relevance to New Zealand and the South West Pacific" category was considered responsive to Maori and likely to make a significant advance in Maori knowledge. In this round only the research of the successful recipient in the "Research of Relevance to New Zealand and the South West Pacific" category was considered responsive to Maori.

The number of Maori *Teacher Fellowships* is slowly increasing. The use of those involved in promotion of the programme to their colleagues has produced further increases, with three of the four Maori applicants for 2003 being successful.

Increasing global connectivity

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

Most *Marsden Fund* contracts enjoy strong international linkages, through collaboration and participation in international conferences. The *Marsden Fund* Council is strongly supportive of such activities and funds them accordingly.

In respect of researchers who are employed in overseas institutions and contributing to a *Marsden Fund* project, the *Marsden Fund* follows usual international practice. It does not fund salary, but it does fund other costs such as travel and accommodation. In respect of funding salary, the only requirement is that the researcher be New Zealand based; this means, for example, that many postdoctoral fellows originating from overseas, but working in New Zealand, are supported by the *Marsden Fund*. While these researchers might return home, collaborative links continue.

The Royal Society has excellent links with overseas funding agencies, brought about by visits to these agencies by the *Marsden Fund* Chair and Manager in 2001. The Society is now part of a network for exchanging information and for access to advice about funding processes. The Evaluation Officer for the Royal Society, Dr Andrea Knox, has made extensive use of these links in establishing processes within the Society for the systematic evaluation of its funding programmes. As a consequence of the visit to overseas funding agencies by the *Marsden Fund* Chair and Manager, the Society is now part of an excellent network for exchanging information and for access to advice about funding processes and opportunities for New Zealand researchers.

All *James Cook Research Fellowships* to-date have undertaken research in collaboration with overseas researchers, either visiting other countries for short periods, or hosting overseas researchers in New Zealand. Also Fellows attend overseas conferences to promote and develop their research, thereby increasing global linkages and network.

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

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

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

Evaluating and reporting progress

The Marsden, James Cook Research Fellowships, Teacher Fellowships, ISAT, and the Contestable S&T Promotion Fund's all have monitoring procedures in place, and the information obtained is presented in this report. The Society recruited an Evaluation Officer in September 2001, who has significantly increased the Royal Society's evaluation capacity. For all the contestable funds, monitoring and evaluation procedures have been or are being reviewed. Specific evaluation initiatives include:

Marsden Fund:
Evaluation will be enhanced with the introduction of electronic reporting for contractors, and revision of the data gathered in site visits. A survey of Marsden postdoctoral fellows was carried out (results reported in this document), and a bibliometric study of publications generated from Marsden-funded research is planned for 2002-3.

Teacher Fellowships:
In a new initiative, past Teacher Fellows were tracked down to find out what they are doing now (results reported herein). This tracking will be repeated every two years. Improved application forms to allow gathering of better demographic information on Teacher Fellows will be developed.

ISAT:
A new template for progress reports has been developed for ISAT contracts. This allows improved gathering of data for evaluation of the fund. The introduction of electronic reporting is planned.
S&T Promotion Fund:

A review of the fund, for which past applicants were surveyed or interviewed, was carried out in February 2002. Grant recipients are now required to carry out an appropriate level of evaluation of the effectiveness of their projects.

James Cook Fellowships:
A survey of James Cook Fellows was carried out in March 2002, and the results have important implications for the level of funding of the scheme (as reported in this document).

Data from routine monitoring of programmes are reported annually in the Progress and Achievements Report. The results of one-off studies such as the James Cook Research Fellowships Survey are summarised in this report, and full reports are also disseminated to interested parties.

APPENDICES

APPENDIX I

Tracking of Past Marsden-funded Postdoctoral Fellows

1. Introduction

Postdoctoral fellows formerly funded by the Marsden fund were surveyed to find out where they are now, what they are doing, and what their attitudes are towards doing research in New Zealand. The survey was done in collaboration with HRC and FRST, who tracked their own formerly funded students and postdoctoral fellows.

2. Results

Response Rate

39 of the 83 Marsden fellows responded (47% response rate). The overall response rate across all RSNZ/FRST/HRC schemes was 36%.

Experience and Age

- 23% said that they had not yet finished their Marsden-funded fellowships (some confusion among respondents may have arisen due to the fact that Marsden grants are not awarded directly to postdoctoral fellows)
- 65% were <4 years since completion of their fellowships
- 12% were 4-8 years since completion

64% of those who had completed were still in their first position after completion of their fellowship

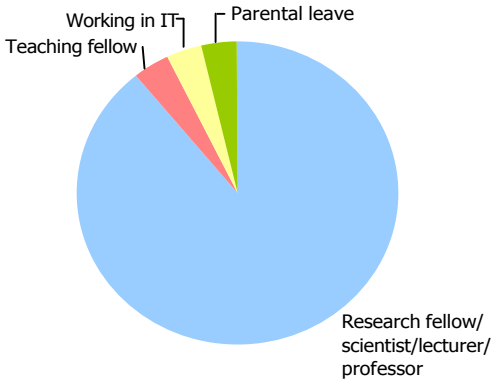
Age:
- 7% <30 years old
- 82% 30-39 years old
- 7% 40-49 years old
- 4% 50+ years old

Career Path

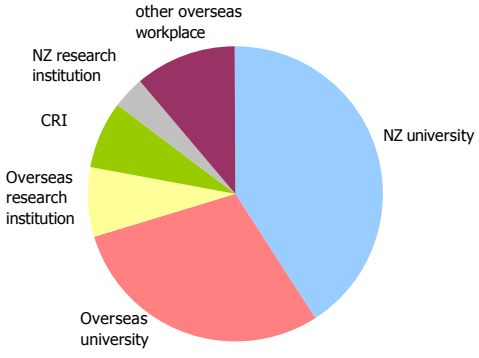
After completion of their fellowships, the majority of Marsden fellows continued in research:
- 86% (25/28 respondents) were working as research fellows, scientists, or lecturers/professors at the time of the survey/in their most recent positions
- 3% (1) were working in IT
- 3% (1) were teaching fellows
- 3% (1) were on parental leave

Most fellows were working in universities:
- 41% (11/27 respondents) were working at NZ universities at the time of the survey
- 30% (8/27) were at overseas universities
- 7% (2/27) were at CRIs
- 7% (2/27) were at overseas research institutions
- 4% (1/27) were at a NZ research institution
- 11% (3/27) were at other types of workplaces overseas (government

Current profession of Marsden fellows



Current place of work

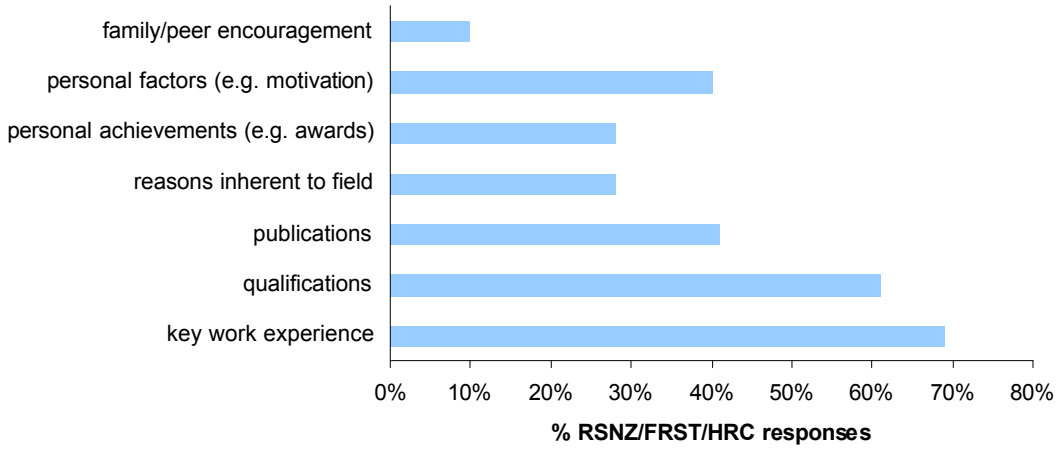


department/private company/ educational institute other than a university)

We asked about factors that had supported their careers and factors that had a constraining effect. The most important factors that helped fellows to gain employment in their preferred area of expertise (total RSNZ/FRST/ HRC population) were:

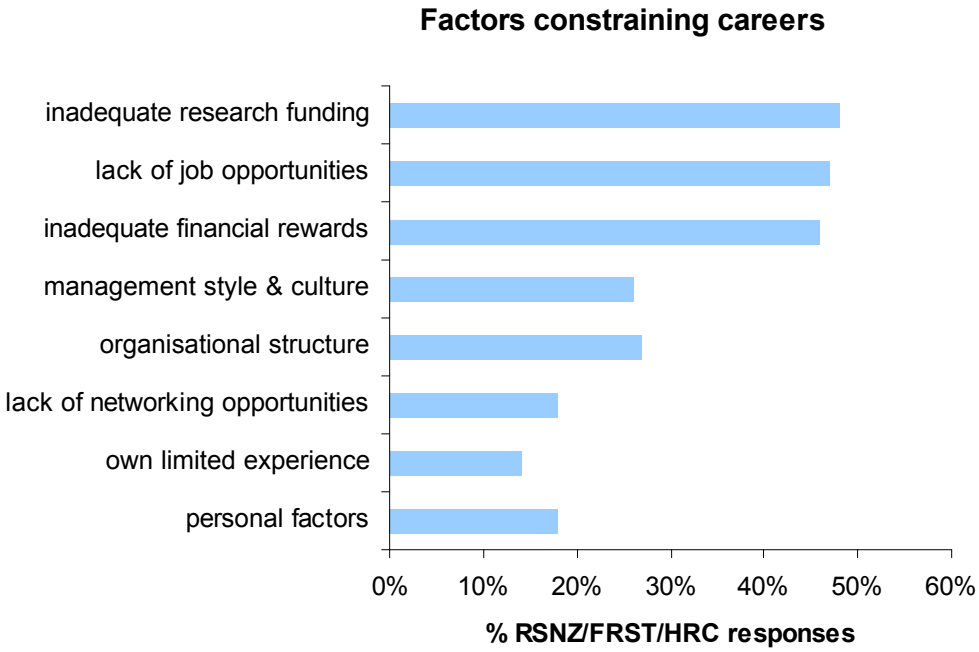
- key work experience (69%)
- qualifications (61%)
- peer reviewed publications (41%)
- personal factors, e.g. intrinsic motivation (40%)
- reasons inherent to the field, e.g. interesting research results (28%)
- personal achievements, e.g. awards/recognition for excellence (28%)
- family/peer encouragement (10%)

Factors that helped fellows gain preferred employment



The main factors that had constrained careers (total RSNZ/FRST/HRC population) were:

- inadequate research funding (48%)
- lack of job opportunities (47%)
- inadequate financial rewards (46%)
- management style and culture (26%)
- organisational structure, e.g. mobility/flexibility (27%)
- lack of opportunities to network and keep up to date (18%)
- personal factors (18%)
- fellows' own limited experience (14%)



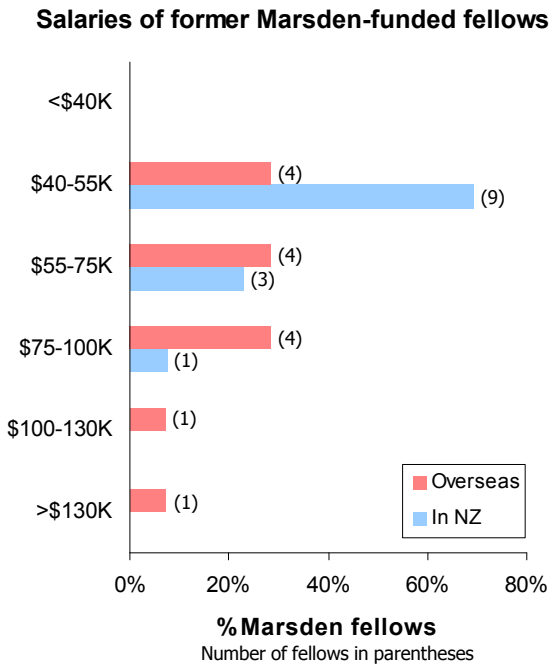
Dissatisfaction with their career progress was expressed by 22% of respondents. The main reasons given were job insecurity, funding difficulties/insecurities, and a lack of suitable employment opportunities. Of those who were satisfied with their career progress, the most commonly given reasons were that they were engaged in satisfying research, they had gained suitable employment, and they had received good mentoring.

Salaries

Lack of financial rewards was one of the most commonly specified career-constraining factors.

Most former Marsden-funded fellows who are working in New Zealand are earning within the $40-$55k salary bracket. A smaller number earn over $55k (see graph below). This contrasts with those working overseas, most of whom earn more than (the equivalent of) NZ$55k. Although numbers of respondents are too low for this finding to be statistically significant, it is in accordance with findings for FRST postdocs <http://www.frst.govt.nz/About/evaluation/TrackingSurvey.cfm>.
Formerly HRC-funded postdocs earned more, on average, possibly due to the clinical nature of their work, and due to the fact that the HRC fellows tended to be older.

The average New Zealand wage in 2001 was around $35k before tax (Statistics New Zealand quarterly employment survey). Former postdoctoral fellows are therefore earning above this wage. However, it must be remembered that they have completed at least seven years of tertiary study, followed by at least three years of postdoctoral training and thus will compare their salaries to professions that require similar amounts of training (e.g. medicine, law). Only 3.2% of New Zealanders aged 15 years or over had a higher degree in 2001 (Census, 2001)



Perceptions of Scheme's Effectiveness

Ten Fellows out of 24 (42%) said that their Marsden Fellowship had influenced their career plans. The finding that most felt it had not affected their plans may reflect a tendency for postdoctoral fellows to be already quite sure of their career plans.

In their first positions after completion of their Marsden-funded fellowship, 90% built on expertise developed during the fellowship. In subsequent positions 78% were still building on this expertise.

Overseas Respondents

Within the total RSNZ/FRST/HRC population, just fewer than 30% were overseas at the time of the survey. Within the Marsden group, 50% (15) were overseas. This reflects the relatively high proportion of Marsden postdoctoral fellows who are non-New Zealand nationals, and it may also reflect the internationally competitive nature of Marsden-funded research.

Overseas Marsden fellows were asked if they wanted to return to New Zealand.
- 20% said that they wanted to return to New Zealand
- 13% said that they did not want to return to New Zealand
- 66% were unsure

These proportions are in accordance with figures from the total RSNZ/FRST/HRC population. The large percentage of respondents who were unsure suggests that there is scope for initiatives to attract these people back to New Zealand.

When asked what factors would influence them to return, the most common factors given (by the total RSNZ/FRST/HRC population) were:
- a job offer/employment opportunities (29%)
- a *desirable* job offer (29%)
- personal/family reasons (24%)
- availability of research funding (17%)

FRST have made the full survey report available on the web, at:
<http://www.frst.govt.nz/About/evaluation/TrackingSurvey.cfm>

APPENDIX II

Quantitative Indicators and Qualitative Achievements

1 Excellence in the advancement of knowledge

The quality of Marsden-funded research is ensured by rigorous selection procedures including national and international peer review. Measures of research excellence for contracts current in the 2001-02 year are as follows:

- Papers on current and past Marsden contracts have been published in prestigious journals with high impact factors such as *Science, Physical Review Letters, Angewandte Chemie, Nature Cell Biology, Proceedings of National Academy of Sciences, Journal of Bacteriology, Journal of Biological Chemistry, The Plant Cell, Developmental Psychology, American Ethnologist, University of Toronto Law Journal.* Several books have also been published this year from current and past Marsden contracts, including *The Book of Iris- A Life of Robin Hyde* by Derek Challis and Gloria Rawlinson, *A Country of Writing* by Lydia Wevers, *Geometric Function Theory and Non-linear Analysis* by Tadeusz Iwaniec and Gaven Martin, *Carved Histories* by Roger Neich, *New Science of Intimate Relationships* by Garth Fletcher and *Punishment and Civilisation* by John Pratt.
- The results from 65% of current contracts (excluding those awarded in 2001/02) have been presented at international conferences.
- Investigators from 33% of current contracts (excluding those awarded in 2001/02) have been invited speakers at conferences.
- Of the 8 holders of the prestigious James Cook Research Fellowships with tenure during the 2001/02 year, 5 are principal investigators on current Marsden contracts.
- Numerous prizes and awards to Marsden researchers, as listed in Table A1. These include both New Zealand and international recognition, for principal and associate investigators, postdoctoral fellows, and postgraduate students funded in Marsden programmes.

Table A1: Prizes and awards for Marsden-funded researchers

Marsden researcher	Contract	Distinction awarded
Professor Vaughan Jones	MRI101 MRI801	Distinguished Companion of the New Zealand Order of Merit
Professor Diana Hill	UOO604	Companion of the New Zealand Order of Merit, 2002
Dr Jean Fleming	AGR701	Officer of the New Zealand Order of Merit
Professor Michael Corballis	UOA813 UOA011	Officer of the New Zealand Order of Merit
Professor Peter Schwerdtfeger	UOA616 UOA911	James Cook Research Fellow 2002
Associate Professor Robert Poulin	UOO011	James Cook Research Fellow 2002
Associate Professor Robert Poulin	UOO011	NZ Association of Scientists Research Medal 2001
Professor Peter Schwerdtfeger	UOA616 UOA911	The 2001 Hector Medal (RSNZ)
Associate Professor Wei Gao	UOA119	The 2001 R J Scott Medal (RSNZ)
Dr Ralph Bungard	UOC002	The 2001 Hamilton Memorial Prize (RSNZ)
Dr Richard Blaikie	UOC604 UOC803	The 2001 T K Sidey Medal (RSNZ)
Dr Scott Baker	UOA131	NZ Science and Technology Medal (RSNZ)
Professor Graham Nuthall	UOC707	NZ Science and Technology Medal (RSNZ)
Dr Ross Beever	HRT701 GRD001	NZ Science and Technology Medal (RSNZ)
Dr Carol Taylor	MAU007	2001 Easterfield Award (NZ Institute of Chemistry)
Professor Geoff Stedman	UOC106	The University of Canterbury Research Medal 2001
Professor Charles Higham	UOO007	Inaugural University of Otago Distinguished Research Medal Lecture

Professor Margaret Brimble	UOA803 UOA118	Elected as Fellow of the RSNZ, 2001
Dr Robert Buckley	IRL703	Appointed as Fellow of the RSNZ, 2001
Associate Professor Robert Poulin	UOO011	Appointed as Fellow of the RSNZ, 2001
Professor Geoff Whittle	VUW901	Appointed as Fellow of the RSNZ, 2001
Associate Professor Wei Gao	UOA119	Appointed as Fellow of the RSNZ, 2001
Dr Colin Wilson	GNS601	Appointed as Fellow of the RSNZ, 2001
Dr William Wilson	CSO701	Appointed as Fellow of the RSNZ, 2001
Prof Paul Callaghan	VUW005	Elected President of RSNZ Academy Council
Prof Paul Callaghan	VUW005	Inaugural appointee to the Alan MacDiarmid chair of physical sciences at Victoria University
Professor Peter Walls	VUW803	Appointed CEO of NZ Symphony Orchestra
Professor James Belich	UOA819	Fulbright Visiting Fellowship in USA, 2000.
Dr Grant Williams	IRL801	Von Humboldt Fellowship
Dr Reuben Brown	UOA911	Von Humboldt Fellowship
Professor Gaven Martin	UOA811	Swedish Royal Academy of Sciences Fellow
Dr Robin Speedy	PVT801	Awarded Canadian SHARCNET visiting fellowship
Dr Bryan Lawrence	UOC701	PI elected to International Commission for Middle Atmosphere
Dr Simon C Malpas	UOA804	Arthur C Guyton Award for Excellence in Integrative Physiology (American Physiological Society)
Professor Gerald Tannock	MAU907	Appointed as a Fellow of the American Academy of Microbiology
Dr Paul Shorten	UOC515	Hatherton Medal
Valerie Leung	UOC006	RHT Bates Scholarship 2002
Dr V Nikora	NIW001	Best Science Paper at a NZ conference.
Dr David Bainbridge	UOW805	Best Paper award at a US conference.
Dr Denis Loiselle	UOA604	Postdoctoral fellow Dr Andrew Taberner has been awarded a FRST postdoctoral fellowship and will go to MIT in the USA
Professor Geoff Whittle	VUW901	Masters student, Dillon Mayhew, awarded a Commonwealth Scholarship, the second student on this grant to receive one.
Mark Bart	UOC909	Student won best poster prize at overseas conference
Daniel Milligan	UOC705	Student won Best Poster prize at Australian conference
Olivia Haine	UOA914	Student prize for best paper, Aust. Marine Sciences Ass. & NZ Sci. Soc. Meeting 2001
Marjan Askarian Amiri	UOO901	Student won Best Poster Prize at NZ conference
Mary Gower	UOC004	Student won best poster prize at NZIC conference
Sara Metcalf	UOA018	Student won departmental “best seminar by student” award.
Gayle Ferguson	UOC902	Student awarded “Best Student Presentation” by the NZ Microbiological Society.

2 Underpinning the Knowledge Base

Kevin Gould was funded by Marsden to investigate what makes the leaves of some New Zealand native trees red, and what role the red pigments play. His major discovery was that the pigments destroy damaging free radicals.

Dr Gould's work has been featured on the cover of two international plant research journals (*Physiologia Plantarum* and *Journal of Experimental Botany*). The outputs from the project include 6 published papers, 12 conference presentations (several invited), and 2 popular articles. Dr Gould also organised a conference and co-edited a special edition of a journal. The project supported a PhD student, who was able to travel to a collaborator's lab in the US to learn new techniques. The project received much media attention; Dr Gould was interviewed on National Radio's Kim Hill Show, and the research was featured in the *New Zealand Herald*. Articles are to appear in *New Scientist* and *New Zealand Geographic*.

Funding is being sought to extend the study to the pigment's effect in animal cells.

Basic research contributes to the knowledge base, primarily by peer-reviewed publication. Where appropriate, other types of knowledge dissemination are encouraged.

In the 2001/02 year there were 274 existing contracts (not including the 82 new contracts from the 2000 funding round), and 88 of these have presented their final reports. Publications and outputs to date arising from these completed contracts are listed in Table A2.

Table A2: Publications and other outputs for 88 contracts completed in 2001/02

Publications
• 491 papers in refereed journals (including 98 papers in press)
• 5 books published
• 67 book chapters (including 16 in press)
• 113 refereed conference proceedings (including 20 in press)
Conferences
• 612 conference and workshop presentations
Newspaper articles
• At least 57

3 Broadening and Deepening the Research Skill Base

3.1 Investing in New Zealanders with knowledge, skills and ideas

The Marsden Fund has supported and retained skilled New Zealanders by:

- Funding contracts starting in the 2001/02 year that involve 113 principal investigators (of whom 96% are based in New Zealand) and 89 associate investigators (of whom 64% are based in New Zealand).

3.2 Investing in emerging researchers

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

- 20 Fast-Start contracts were awarded in 2001/02, to researchers who have had no more than 7 years' research experience since completing their Ph.D.
- The Marsden Fund's contracts support approximately the same number of postdoctoral researchers as the NZ Science & Technology Postdoctoral Fellowships scheme, administered by FRST. For the 467 contracts awarded between 1996 and 2001, funding has been available for postdocs in 40% of them, providing the equivalent of 154 full-time 3-year appointments. In the 2001/02 year, the first year of new contracts has supported 26 FTE postdoctoral positions.

- For the 467 contracts awarded between 1996 and 2001, funding has been available for postgraduate students in 53% of them. In the 2000/01 funding round, the first year of new contracts has supported 44 FTE postgraduate positions.
- In 2001/02, 38% of all principal investigators and 24% of all associate investigators are within just 10 years of completing their PhD (that is, in most cases, are under 35 years of age). Last year, the corresponding figures were 27% and 43%, respectively. This indicates that the role for emerging researchers has shifted strongly from associate to principal investigator. The participation of emerging researchers is significantly greater than would be expected from demographic considerations alone (Figures A1a and A1b).

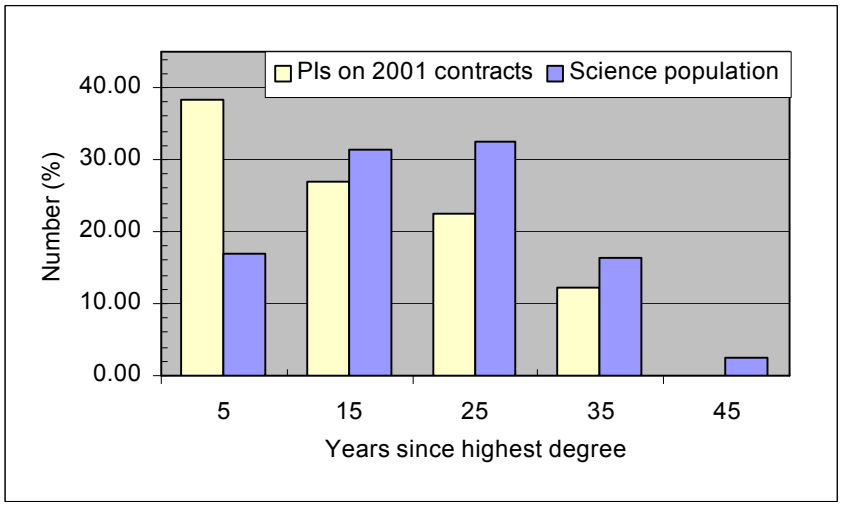
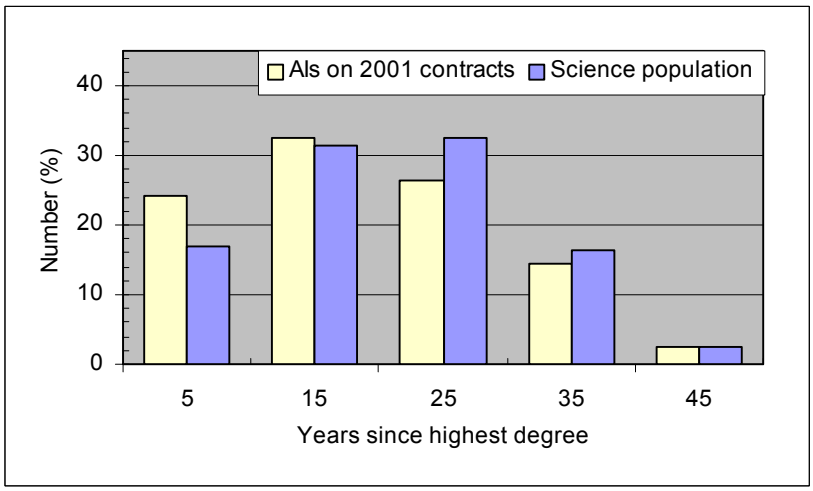


Figure A1a: Experience of principal investigators (PIs) on contracts awarded in 2001/02, as measured by the number of years since the principal investigator obtained their highest degree. Since 85% of contracts are in the science area, this distribution for principal investigators has been compared with the distribution of ages of New Zealand scientists, from *Profiles – A Survey of New Zealand Scientists and Technologists*[2]. [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.

Figure A1b: Experience of associate investigators (AIs) on contracts awarded in 2001/02, as measured by the number of years since the associate investigator obtained their highest degree. The contribution of young researchers is less marked than for principal investigators (Figure A1a).

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

- In several cases, post-doctoral fellows have been supported on Marsden contracts who have then progressed to become principal investigators on their own Marsden grants.
- There are examples of postgraduate students being supported by Marsden, gaining their PhDs and then going on to become post-doctoral fellows on separate Marsden grants, with different principal investigators.

3.3 Supporting participation of women

In 2001/02, 25% of the principal investigators on successful applications are women. Excluding the social sciences and humanities, the figure drops to 17%[3]. For the previous year, the figures were 18% and 13% respectively.

The fund has actively promoted the participation of women by:

- Promoting through the media the achievements of female researchers on Marsden contracts.
- Maintaining gender balance in management, assessing panels and the Marsden Fund Council.
- Encouraging women as principal investigators. The percentage of principal investigators who are women has increased fourfold since the 1995 round. This trend is summarised in Figure A2.

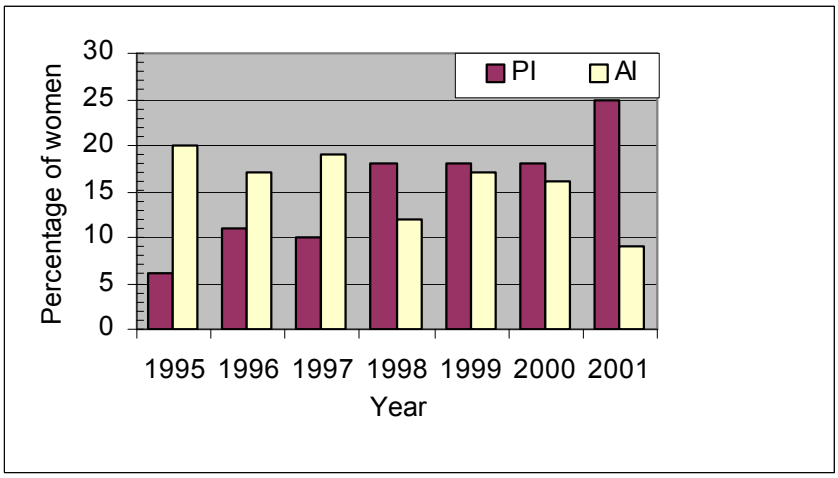


Figure A2: Percentage of investigators, principal (PI) and associate (AI), who are women.

3.4 Supporting participation by Maori

For contracts active in the 2001/02 year, the percentage of principal and associate investigators who are Maori is 2.2%, although Maori researchers contribute to 5% of the contracts, across all 8 panel areas. In the 1997 Royal Society survey (referred to above), 0.7% of scientists were identified as Maori.

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

- Publicising research conducted by Maori, or of specific interest to Maori, through written media, radio, and the Marsden Fund newsletter.
- Participating in hui-a-rohe, organised by MoRST, to discuss the role that research science and technology has in supporting Maori and iwi development through matauranga Maori and innovation.

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

- Contributing to the Victoria University Science Faculty mentoring scheme*, Te Ropu Awhina Putaiao*.

4 Quality of the Research Environment

4.1 Supporting collaboration

The proportion of the contracts involving principal and associate investigators at more than one institution has risen steadily from 23% in 1995 to 53% in the 2000 funding round (Figure A3). The drop in the 2001/02 round to around the 1998 level is unlikely to indicate a reversal in the long-term trend.

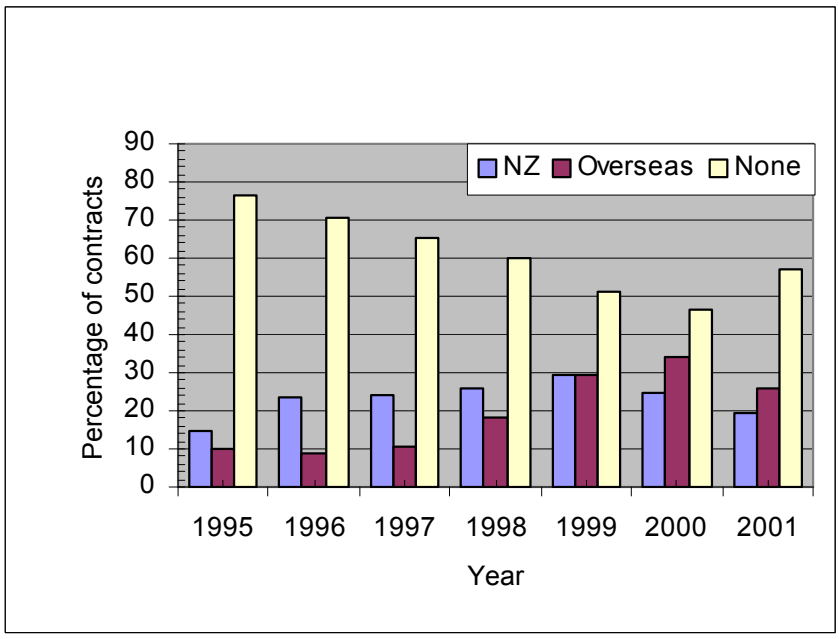


Figure A3: The percentage of contracts for which a principal or associate investigator is from outside the host institution, categorised according to whether the collaborator is from New Zealand or from overseas. The percentage of contracts having no such formal collaboration is also shown. The year refers to the starting date of the contract.

The percentage of contracts that specifically include overseas principal or associate investigators is 26% for this funding round. Further collaboration occurs during the course of the research and the percentage of current projects with international collaboration is 67%.

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

- Using techniques, equipment or resources that are unavailable in New Zealand, often at no cost. Examples include:
  - A PhD student visiting the University of Goettingen to carry out microprobe analysis of geological samples.
  - The principal investigator, postdoc and PhD student visiting and working at the Lizard Island Research Station, a marine research facility on the Great Barrier Reef.
  - The associate investigator visiting a synchrotron source in the USA for analysis of crystals.
- Sending New Zealand researchers, including students, to overseas laboratories to learn new methods not available in New Zealand. Examples include:
  - A PhD student visiting a collaborator's group in Georgia, USA, to learn new skills in bioinformatics.
  - A postdoc visiting Melbourne to carry out structural analysis of a protein.
- Obtaining placements for promising New Zealand researchers with top overseas researchers. Examples include:

  - A student graduating with a PhD from a Marsden programme and being appointed as a postdoctoral fellow in the group of a Nobel laureate in physics.
  - A post-doctoral fellow supported on a Marsden grant being awarded a prestigious international fellowship to work in the Swiss laboratory of a Nobel laureate in medicine. She intends to return to New Zealand to develop her career as an independent researcher.
- Drawing on overseas researchers' knowledge by hosting conferences, workshops and individual visits. Examples include:
  - A yearly meeting on mathematics in which New Zealand-born Fields Medal winner, Professor Vaughan Jones, hosts some of the world's best mathematicians to work with local researchers and students.
  - The organisation of regular mathematical workshops to advance knowledge in the area of differential equations.
  - A geological workshop, investigating the tectonic history of Fiordland, attended by approximately 30 American and New Zealand researchers.
  - A mathematical workshop on stochastic global optimisation, attended by 20 researchers from Europe, America and Australasia.
- Hosting young researchers and students from overseas to build links for the future. Examples include:
  - Two young researchers from the China Seismological Bureau spent 6 months in New Zealand, learning techniques and software related to statistical seismology.
  - A student from Paris spent 6 months contributing to an experimental programme on Bose-Einstein condensation.
- Leveraging Marsden funding with overseas funding. Examples include:
  - The PI visited USA in 2001 and was hosted at a number of universities A Fulbright Visiting fellowship paid for this trip and the universities met his visiting costs. The researcher says, "I was able to restrict expenses chargeable to the Marsden grant to US$2661.04, possibly a record low for 6 months research in the United States. A trip to Australia is planned for September-October of this year, and will be part-funded by the University of Melbourne….I am delighted to have been able to "leverage" the Marsden grant by obtaining such substantial supporting funds."
  - The PI took study leave in Germany 2001 and was able to obtain DAAD funding for living costs by carrying out a comparative study, of which the Marsden work formed the NZ component.
  - The PI was selected as SHARCNET Senior Visiting Research Fellow, obtaining use of a $6 m computing facility and support worth ~30% of the PI's annual Marsden budget.
  - The PI was invited on a US-led research iron-fertilisation study of the Ross Sea and took measurements which supported the PI's Marsden project.
  - NSF funding was obtained for a NZ workshop that defrayed some of fieldwork costs in Marsden project.
  - NSF funding was obtained for complementary study. This has supported 2 US postdoctoral fellows and several US students who have contributed towards Marsden work.

From 1996 to 2000, the percentage of contracts with a New Zealand collaborator from outside the host institution has been steady at 24-30%. In 2001, there has been a reduction in national collaboration to 20% (Figure A3). The sources of national collaborations are shown in Figure A4.

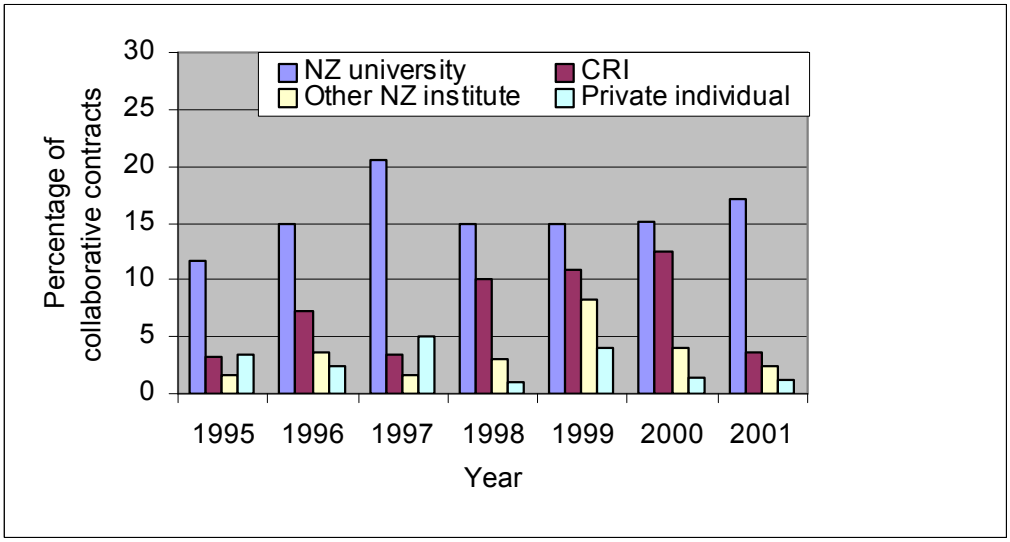


Figure A4: The percentage of contracts for which a principal or associate investigator is in New Zealand and outside the host institution, categorised according to whether the collaborator is from a University, a CRI, any other New Zealand institute, or is a private individual. A particular contract may be represented in more than one category.

4.2 Encouraging multidisciplinary research

There are many examples in Marsden-funded projects where research spans one or more traditional disciplines, including:

- A study which brings chemistry, biology and ecology to bear on algal growth in the Southern Ocean, to increase understanding of climate.
- A study in which physics, biology and mathematical modelling are used to determine the turbulent properties of the upper ocean, by measuring the response of plankton to variations in light levels caused by vertical mixing.
- A study in which sophisticated optical measurements and image processing have been used to obtain high resolution images of the junctions which connect cells in the lens of the eye, with implications for the understanding of the flow of nutrients and of the formation of cataracts.
- An evolutionary biology study in which a hydrographic model has been applied to ascertain whether New Zealand fiords provide physical barriers to species.
- A study in which the links of abstract mathematical concepts to language are examined, to determine whether mathematics is a universal form of human thought or whether it is culturally determined.
- A study in which physical measurements and sophisticated computer modelling will increase understanding of potentially fatal heart rhythm disturbances.

Comprehensive lists of other such projects have been provided in the 2000 Strategic Report and the 2001 Progress and Achievement Report.

The change in the amount of multidisciplinary research with time can be quantified by using the OECD classification of research fields and shows that the percentage of multidisciplinary contracts has stayed constant at 59-63% over the last 4 funding years. This method of measuring multidisciplinary research includes traditional multidisciplinary groupings such as physics/mathematics and biology/chemistry and this is the likely reason that the figure has remained so constant. It is more appropriate to consider novel groupings where the research is breaking new ground, such as those listed above.

4.3 Promoting a culture supportive of research, science and technology

The Marsden Fund plays a key role in promoting this culture by, for example:

- Publishing a quarterly newsletter highlighting Marsden research.
- Providing press announcements to coincide with the announcement of Marsden funding. This resulted in coverage on radio and in at least 17 metropolitan and provincial newspapers throughout New Zealand, with some newspapers printing several stories.
- Contributing to a diversity of promotional activities, often under the umbrella of the Royal Society. Examples include science fairs, Royal Society publications, and responses to requests for information from the media, Government departments, school children, research providers, etc.

Marsden researchers also promote this culture by, for example:

- Publicising their research in the media, particularly newspapers and radio.
- Using their international standing to promote New Zealand as a venue for major conferences. Professor Warren Tate hosted a "Dynamics of Ribosome Structure" conference in Queenstown, Professor Margaret Brimble is co-chair of a prestigious international conference on organic synthesis to be held in Christchurch in July 2002, and Professor Vernon Squire is co-convenor of two major conferences on ice, to be held in Dunedin in 2002 and 2005.

4.4 Additional Outcomes

Some extracts from Annual Reports indicate some other types of outcome:

- Serendipity

"The highlight was the serendipitous discovery of a new highly fluorescent molecule. To our surprise, this simple type of organic fluorophore had never been described despite the enormous work by the dye industry last century. At the present time we are getting professional advice as to whether to patent these compounds before publishing."

- Commercial potential

"The concept of wavefront measurement in white light has been successfully developed. We now expect to develop this concept further and apply it to adaptive optics systems with commercial potential, as part of a NERF project. This clearly demonstrates the value of Marsden funding in providing the ability for researchers in New Zealand to generate basic knowledge from fundamental research which can then be developed further for the commercial benefit of the country."

- Capability

"This Marsden programme has dramatically enhanced New Zealand's capability in nanotechnology and established a centre of nanotechnology at the University of Canterbury."

- World development

"Our acronym extractor has been embedded into the Greenstone digital library software. Use of this software has mushroomed during the year (for example, it will be distributed by UNESCO for digital library creation in developing countries in a project that will come to completion in mid-2002), giving many other research and applications groups access to the new technique."

APPENDIX III

Marsden Fund contribution to issues of public interest

Issue	No. of pro-programmes[4]	Funding ($m)	Description
Genetic technology	92 (incl. 27 for use as a tool)	10.5 (incl. 2.4 for use as a tool)	In laboratory-based studies, understanding the way in which genes work, in relation to general cell biology, protein biochemistry, plant function and human health. Use as a routine tool to sequence DNA, for evolutionary, ecological and historical studies.
Environment	43	3.5	Programmes are investigating aspects of ecology, biodiversity, population genetics, plant physiology, oceanography and atmospheric science. Programmes of particular public interest include genetic studies of the threatened native black robin, the effect of brown trout on the ecosystem and factors that determine the sex of tuatara.
Health	65	6.4	Most programmes concentrate on fundamental aspects of biochemistry, cell biology and genetics. The focuses of the programmes include the immune system, the nervous system, disease-causing organisms, degenerative diseases, cancer research, drug synthesis, gene therapy, and statistical and computational methods.
Maori	12	0.87	Archaeology, language, Maori language newspapers, political representation, settlement, museum practice, health, and Ta Moko.
Children and adolescents	7	0.45	The development of memory, how students learn and acquire knowledge, and children's rights including the right to be safe.
Natural hazards	9	0.60	Geothermal, volcanic or seismic activity.
Climate change	5	0.48	Programmes determining past climate, which provides information for today's debate on climate change and one investigating the mechanism by which the greenhouse gas carbon dioxide is permanently trapped by the oceans.
Information technology	21	1.1	Computer architecture, software, data transmission, artificial intelligence, numerical computation and the theory of computation.
New materials and nanotechnology	25 (incl. 10 in nanotech)	2.4 (incl. 1.1 in nanotech)	Investigating new materials, including developing materials and material processes for nanotechnology.
Developmental biology	43	5.3	Investigating various aspects of plant and animal development (eg. muscle development, the control of flowering), as well as various aspects of learning and memory development.

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

APPENDIX IV

Areas of strength in Marsden-funded research

Panel	Strengths
Biomedical Sciences (BMS)	Strong areas include protein structure and function, genetics and genomics, neurobiology, immunology, the nervous system, disease-causing organisms, degenerative diseases, cancer research, drug synthesis, gene therapy, and statistical and computational methods. Overall, modern biochemistry, physiology, molecular biology and cell biology are well represented. Many studies are multi-disciplinary.
Cellular, Molecular and Physiological Biology (CMP) and Ecology, Evolution and Behaviour (EEB)	The following are strongly represented: Plant molecular biology; molecular and protein biochemistry; genetics; molecular evolution; marine ecology; biodiversity and biogeography.
Physical Sciences and Engineering (PSE)	New Zealand's traditional strength in synthetic chemistry is well represented including: utilization of naturally occurring compounds; design of products with specific biological function; new materials. There is a developing strength in nanochemistry (such as molecular switches, self-assembly), and a presence in physical chemistry. Physics is strongly represented in condensed matter, (particularly in superconductivity and electron transport), and in ultra cold atoms (Bose-Einstein condensation). The number of engineering projects has increased significantly this year, and includes imaging, fluid dynamics, and metal fatigue.
Earth Sciences and Astronomy (ESA)	Strong areas are climate related research, especially climate processes and palaeoclimate, fluid physics, ice physics, astronomy, tectonics, oceanography, sedimentology, and palaeontology.
Mathematical and Information Sciences (MIS)	The Marsden Fund is supporting an impressive array of research across a wide spectrum of areas, including abstract geometry and analysis, biomathematics, combinatorics, computability theory, computational algebra, computer architecture and graphics, mathematical biology, numerical methods, and statistical methods and modelling.
Social Sciences (SOC)	Marsden funds a large range of psychology projects. Education, economics, sociology, human geography, and political science are well represented.
Humanities (HUM)	Strong areas include the Print Culture initiative, Maori studies ranging from print media through to current museum practices, New Zealand linguistics, New Zealand literature, New Zealand history, and ethics. The wide diversity of disciplines funded, of national and international importance, contributes to the strength of English literature, Pacific studies, European history, media studies, and the arts.

Areas under-represented in Marsden-funded research

Panel	Under-represented areas
Biomedical Sciences (BMS) and	Studies on microbiology and infectious diseases are not well represented (this is also true in New Zealand as a whole). Other areas under-represented are virology, dental science, nutrition, pharmacology and biomedical engineering. There are also very few studies on the basic aspects of diabetes and obesity, and health studies relevant to Maori and Pacific Islanders.
Cellular, Molecular and Physiological Biology (CMP) and Ecology, Evolution and Behaviour (EEB)	Under-represented areas in the CMP and EEB areas are microbiology; animal and plant physiology; ecophysiology; evolution and ecology; behavioural ecology.
Physical Sciences and Engineering (PSE)	There is little polymer chemistry, although one project was funded this year. The traditionally important area of analytic chemistry is not represented. Both areas may be weak across New Zealand. One of the prominent areas in New Zealand physics in the past two decades, quantum optics (and its recent development into quantum information and computing) is not present in the portfolio. Optics and laser physics also appear to be under represented in terms of their international importance.
Earth Sciences and Astronomy (ESA)	There are gaps in soil microbiology, lower atmospheric processes and hydrology. There is also a concern about alternatives for funding astronomy as, at present, the only funding sources are the Marsden Fund and internal university funding.
Mathematical and Information Sciences (MIS)	There are no obvious significant gaps in the range of areas being supported in the current 3-year cycle.
Social Sciences (SOC)	The lack of representation of law and the lack of studies in the business studies/management area are a concern.
Humanities (HUM)	Classics, Asian studies, NZ art history, modern languages and religious studies are under-represented.

APPENDIX V

2001-02 James Cook Research Fellowships

Dr Michael Eccles: Strategic targets for cancer therapy and proliferate disorders – completion date 03/2002 (Health Sciences);

Professor Michael Corballis FRSNZ: Measuring brain activity in human performance—completion date 05/2002 (Biological Sciences);

Dr Jack Vowles FRSNZ: A Better Democracy? People and politics in New Zealand—completion date 05/2002 (Research of relevance to the Peoples' of New Zealand and the South West Pacific).

Professor Graham Le Gros (Health Sciences): Biology of asthma and the search for new therapies—completion date 30 April 2003;

Professor Gavin Martin FRSNZ, (Physical Sciences): Nonlinear analysis and geometry—completion date 30 April 2003;

Professor Josu Arrillaga FRSNZ (Engineering and Technologies Sciences): Modelling of power systems under power electronic control—completion date 30 April 2003.

Professor Judith Binney CNZM FRSNZ (Social Sciences): A History of the Urewera, 1829–1922—completion date 04/2003;

Professor Peter Schwerdtfeger FRSNZ (Physical sciences): The search for electroweak effects in molecules—completion date 03/2004.

APPENDIX VI

Survey of James Cook Research Fellows

Interviews of the 17 James Cook Fellows who were awarded their fellowships between 1996 and 2001 were conducted in order to:

1. Find out what effects the fellowships have on the people to whom they're awarded, on their research, and on the people Fellows work with;
2. Determine ways in which the scheme could be improved.

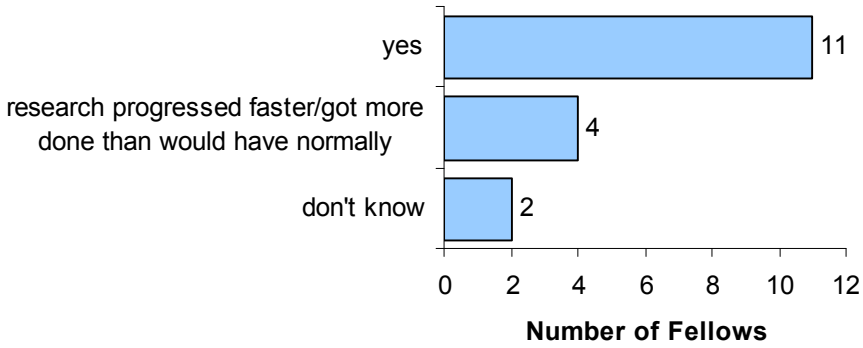
Eight of the 17 Fellows had completed before the end of 2000, and 9 were either current Fellows or had completed after the end of 2000. The 8 who completed before the end of 2000 were asked extra questions about what they have been doing since completion, and how the fellowship had influenced their further work.

All former James Cook Research Fellows are engaged in research

All of the 8 Fellows who completed before the end of 2000 are currently engaged in research. One is overseas, 6 work in NZ universities or CRIs, and 1 is self-employed in New Zealand. All hold senior positions and supervise staff and/or students.

The James Cook Research Fellowships fund research that wouldn't have been possible otherwise

Fellows were asked if the fellowship had enabled them to do research that they wouldn't have been able to do without the fellowship. They answered:



The ways in which the fellowship enabled this research were by:

- providing uninterrupted time for research;
- funding Fellows to work overseas;
- funding research that would not have been funded by any other scheme;
- providing a source of salary.

One Fellow said:

"Prior to the award of the fellowship I was leader of a large team. We were on the beginnings of a commercialisation drive – I had to manage IP. So research is done in the spare time under such circumstances. It freed me from all of that. I spent a lot of time at [an overseas] University, and I was completely free there to focus on my research. It was extremely productive, primarily because that time was available"

Further work builds on James Cook-funded research

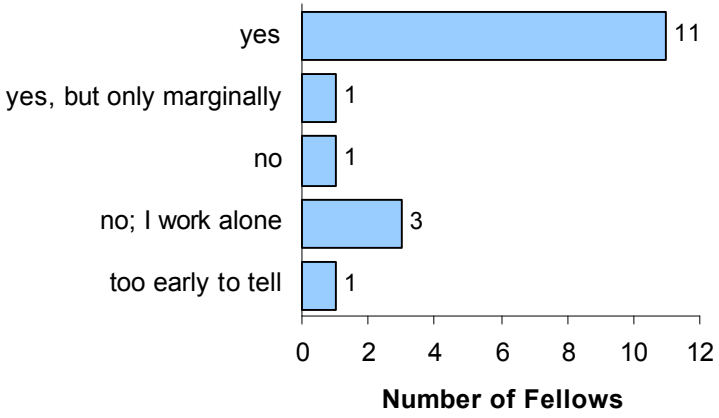
All 8 Fellows who completed before the end of 2000 said that their work subsequent to completion of the fellowship had been influenced by work done on the fellowship. All said that the fellowship had opened up a new research area. For 7, the fellowship enabled the Fellow or a member of their group to gain expertise that was useful for further work. Seven set up ongoing collaborations or made useful contacts during their fellowship, and for 4, access was gained to further funding (from overseas sources, the Marsden Fund, CoRE or NERF).

Effects on careers and reputations

Six of the 17 Fellows stated that the James Cook Fellowship had or probably had a positive effect on their careers and reputations. Seven felt that it had a positive effect on their reputation, but no effect

on their career, with 4 commenting that their careers had already progressed to a high level before award of the fellowship. Four said that they did not know about these effects or that it was too early to tell.

Fellows were asked if their fellowship had had an impact on the careers of their colleagues, students, postdoctoral fellows or research assistants. They answered:



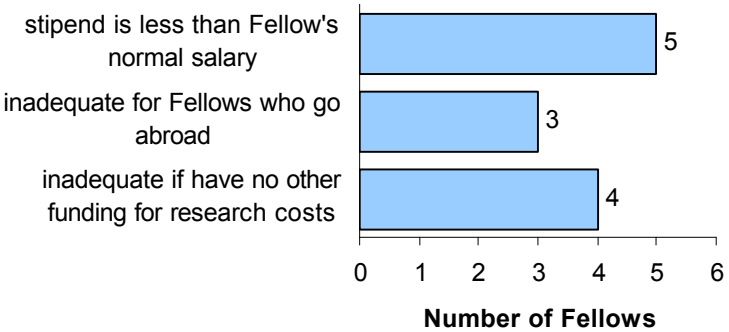
The ways in which it had influenced others' careers were by:

- providing an opportunity for students/staff to develop expertise in the area of the Fellow's James Cook research;
- giving the Fellow more time to interact with others, thus helping their research;
- allowing the Fellow to remain as their mentor;
- allowing the Fellow to employ more staff/students;
- leading to successful funding bids that then allowed the Fellow to employ more staff/students;
- removing the Fellow from undergraduate teaching, thus decreasing his/her influence on undergraduates.

In 2 cases, James Cook research has led to the subsequent establishment of a research institute. Both institutes are involved in developing collaborations and employing and training many people.

Improvements to the scheme

Fifteen of the 17 Fellows felt that there was room for improvement in the scheme. The most commonly stated problem (12 Fellows) was that the level of funding of individual fellowships is inadequate. The reasons given for inadequacy of the stipend were:



Three Fellows said that their Institution had provided a top-up, to restore their salary to its normal level. However, for 2, this had led to problems (e.g. feeling obliged to do administrative work while on the fellowship). Of concern is that the extra cost of top-ups may decrease support for the scheme among employing institutions.

Three Fellows stated that the stipend is inadequate for Fellows who go abroad. A related finding is that more recent Fellows are less likely to spend time abroad:

	Fellowship based in NZ	Fellowship based overseas and in NZ	Fellowship based overseas	*Total*
Finished before end 2000	2	5	1	*8*
Finish after end 2000	7	2	0	*9*

Thus, it appears likely that Fellows are being deterred from spending time abroad by the inadequate stipend. Given that some excellent benefits have accrued from James Cook research that was carried out abroad, this is a serious issue.

Four Fellows stated that the stipend would have been insufficient if they were not able to obtain additional funds to cover their research costs. However, no Fellows actually reported not being able to obtain these funds, so this fear may be unfounded.

Other suggestions for improvements were:
- provide better publicity for Fellows and their work;
- provide more fellowships;
- extend the length of the fellowships;
- implement a better process for granting 3rd year extensions;
- rename the scheme;
- redefine the purpose of the scheme so that Fellows are expected to go overseas;
- consider implementing a two-stage selection process.

In response, the Royal Society is now developing means to provide better publicity and an improved process for granting 3rd year extensions.

Conclusions

This survey found that the James Cook Fellowship scheme is very successful. It has funded some very significant research, all of which is ongoing, and fellowships have produced benefits not just for Fellows, but also for the staff and students they work with. Fellows were very strongly supportive of the scheme, a typical comment was:

"Just total support for what I think is an extremely valuable scheme that has enormous repercussions beyond the actual immediate cost of maintaining the scheme."

There is, however, room for improvement. The most serious problem facing the scheme is that the stipend is inadequate, necessitating top-ups from within institutions, and discouraging Fellows from spending time overseas.

APPENDIX VII

Future Funding of James Cook Research Fellowships

At current funding levels we could support 7 Fellowships at $90,000 annually	$630,000
Plus expenses of 7 x 10,000 each	70,000
But offer no 3rd-year extensions	
Total	**$700,000**

In 2003 we will have four fellowships starting at $100,000	$400,000
Plus expenses of 4 x $10,000 each	$40,000
Ideally we like to offer fellowships in 3 of the 6 disciplines annually	
If we offer 3 new fellowships at $110,000	$330,000
Plus expenses of 3 x 10,000	$30,000
And allow one extension at 110,000 + $10,000 expenses	$120,000
Total	**$920,000**

Since we currently receive $720,000 annually + have $80,000 in the bank, the shortfall in 2003 = $120,000

Extrapolating to 2004

Assume we will have 3 fellowships at $110,000	$330,000
Plus expenses	$30,000
If we offer 3 more fellowships offered at $110,000	$330,000
Plus expenses	$30,000
And allow one extension at 110,000 + $10,000 expenses	$120,000
Total	**$840,000**

That would be a shortfall of $120k on the $720k received currently.

APPENDIX VIII

Tracking of Past Teacher Fellows

Over the years a belief has developed in some quarters that teachers use the NZ Science Mathematics and Technology Teacher Fellowships as a way of finding alternative employment. In order to determine if this is in fact the case, former Teacher Fellows were tracked down and asked about their activities since completion of the fellowship.

171 of the 180 teachers (95%) who were Fellows in the years 1994 through to 2001 were tracked down in May-June 2002.

Return to Teaching after the Fellowship
Overall, 92% returned directly to school teaching after completion of their fellowships. This is broken down by fellowship year in Table 1.

Table 1. % Teacher Fellows who returned directly to school teaching

Fellowship Year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Number Fellowships Awarded	17	19	19	15	16	18	36	40
Number Fellows Tracked	15	16	17	15	16	18	36	38
Number Who Returned to Teaching	15	15	17	14#	15	16[+]	31[+]	34[‡]
% Who Returned to Teaching	*100*	*94*	*100*	*93*	*94*	*89*	*86*	*90*
% Expected to return*	*89.4*	*90.2*	*91.1*	*90.6*	*90.4*	*90.0*	*89.7*	-

* This is the % of state and state-integrated school teachers, teaching in the year indicated, who would be expected to be school teaching in the following year. Calculated from Ministry of Education teacher statistics on loss and return rates (there is no data yet for 2001).
[#] 1 teacher who was counted as not returning was on maternity leave from their school
[†] 1 teacher who was counted as not returning was on secondment from their school
[‡] 1 teacher who was counted as not returning was on sick-leave from their school

Thus, the great majority did return directly to school teaching after their fellowships. The differences between the number who returned and the number who would be expected to return are not statistically significant[5]

Number who are Still Teaching
We found that 77% of former Teacher Fellows were teaching in schools at the time of the survey. The percentages, broken down by year of fellowship, and compared to the percentage that would be expected (from national trends) to remain teaching in schools are presented in Table 2.

Table 2. % Former Teacher Fellows school-teaching at time of survey, compared to national trends

Fellowship Year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
% Fellows currently Teaching	73.3	75.0	88.2	73.3	62.5	77.8	72.2	84.2
% expected*	70.7	73.2	75.0	76.8	80.1	84.1	89.7	-

* This is the % of state and state-integrated schoolteachers, teaching in the year indicated, who would be expected to be school teaching in 2002. Calculated from Ministry of Education teacher statistics on loss and return rates (there is no MoE data yet for 2001).

[5]Using a one-tailed z-test, α ranged from 0.186 to 0.581. α is the probability that the same sized random sample taken from the overall population, would have the characteristics of the Teacher Fellow population. Normally a score of α=0.05 is considered significant.

Thus, for the years 1994-1997, Teacher Fellow data compares well with Ministry of Education statistics, although more recent Teacher Fellows appear to be less likely to be school-teaching at the time of the survey, compared to national trends. The differences between the percentages of ex-teacher Fellows who teach, and the percentages who would be expected to be teaching are not significant however[6], except in the case of year 2000 Teacher Fellows, where ? =0.001.

At what point did the Teacher Fellows who left teaching leave?
Of the 40 ex-Teacher Fellows who are no longer teaching, 70% returned to school teaching after their fellowships, but subsequently left.

There appears to be a trend that those who leave school teaching do not return. Only 2 of the 14 who left teaching directly after completion of their fellowships subsequently returned to school teaching.

What Those Who Left Teaching are Doing
In total, 23% of 1994-2001 Teacher Fellows were not school teaching at the time of the survey. But do the Teacher Fellows who leave teaching still contribute to education?

We found that that 17% were still contributing to the education sector as teachers of children outside the classroom, as tertiary or College of Education teachers, as developers of educational resources, or as advisers to schools or teachers. The breakdown of professions is:

- *2.9%* - teaching children outside of school (at zoo/museum/observatory/local government);
- *1.8%* - teaching at a College of Education;
- *4.1%* - tertiary teaching (at a polytechnic or university - not College of Education);
- *6.4%* - developing educational resources (e.g. at Heurisko, ETITO, RSNZ);
- *1.8%* - providing school/teacher advisory services;
- *1.2%* - scientist/curator;
- *1.2%* - other professions (sales rep, farmer);
- *1.8%* - retired;
- *0.6%* - ill;
- *1.2%* - undertaking tertiary study;
- *0.6%* - currently between jobs

Importantly, we find that a number of the Teacher Fellows who left school-teaching have developed highly original schemes that reach many more students than would be possible within the traditional school setting. Some highlights are given in the main text of this report.

Conclusion
In total, 94% of ex-Teacher Fellows are either still teaching in schools, or contributing in other ways to the education sector. Those who have left teaching have often taken part in, or initiated and directed highly creative, entrepreneurial enterprises that reach large numbers of students.

Three general factors can be expected to influence the number of Teacher Fellows that return to school teaching:

1. The environment within schools (which has been increasingly stressful for teachers in recent years);
2. The availability of jobs for teachers outside of schools;
3. Factors intrinsic to the Fellows. A highly motivated and resourceful person is more likely to make an application and to be successful in gaining a fellowship, and such people may also be more likely to seize opportunities for change, and to run their new ventures successfully.

It remains to be seen whether the finding that more recent Teacher Fellows are less likely than expected to return to teaching is just a temporary aberration, or whether it is the beginning of a trend. Even if it is the beginning of a trend, this may not be a concern, given the finding that the great majority of those who leave teaching continue to contribute to the education sector, often in highly original and influential ways.

[6] For the years 1994-1999, using a one-tailed z-test, α ranged from 0.08 to 0.565.

APPENDIX IX

ISAT Contracts and Values by Country 1998-99 to 2001-02

	98-99	99-00	00-01	01-02	Total	98-99	99-00	00-01	01-02	Total
Asia-Pacific:										
Australia	2	12	6	14	**34**	$3,800	$19,360	$14,040	$27,460	**$64,660**
Cambodia				1	**1**				$2,500	**$2,500**
Fiji			1	1	**2**			$2,000	$1,800	**$3,800**
Hong Kong			1		**1**			$3,000		**$3,000**
India		1		1	**2**		$2,450		$2,200	**$4,650**
Japan	2	5	6	4	**17**	$6,200	$16,130	$20,630	$10,100	**$53,060**
Korea		2			**2**		$4,725			**$4,725**
Malaysia	2				**2**	$4,650				**$4,650**
People's Republic of China	1	1	1	2	**5**	$3,300	$2,590	$2,000	$5,800	**$13,690**
Philippines				1	**1**				$4,000	**$4,000**
Singapore		2	2		**4**		$8,325	$5,500		**$13,825**
Taiwan			1		**1**			$2,100		**$2,100**
Sub-Total Asia-Pacific	**7**	**23**	**18**	**24**	**72**	**$17,950**	**$53,580**	**$49,270**	**$53,860**	**$174,660**
South America:										
Argentina		1	3		**4**		$1,125	$9,950		**$11,075**
Brazil	1	3			**4**	$4,500	$10,695			**$15,195**
Chile		5	2	1	**8**		$15,635	$7,000	$3,400	**$26,035**
Costa Rica			1		**1**			$2,925		**$2,925**
Mexico				1	**1**				$3,100	**$3,100**
Uruguay	1				**1**	$4,310				**$4,310**
Venezuela				1	**1**				$4,000	**$4,000**
Sub-Total South America	**2**	**9**	**6**	**3**	**20**	**$8,810**	**$27,455**	**$19,875**	**$10,500**	**$66,640**
NAFTA:										
Canada			4	4	**8**			$12,375	$12,420	**$24,795**
USA	26	24	17	20	**87**	$86,985	$89,125	$52,760	$71,350	**$300,220**
Sub-Total NAFTA	**26**	**24**	**21**	**24**	**95**	**$86,985**	**$89,125**	**$65,135**	**$83,770**	**$325,015**
Europe:										
Austria	1		1		**2**	$4,000		$4,430		**$8,430**
Belgium				3	**3**				$9,000	**$9,000**
Czechoslovakia	1				**1**	$2,800				**$2,800**
Denmark		2	1		**3**		$7,945	$3,000		**$10,945**
France		1	6	1	**8**		$2,820	$17,440	$4,000	**$24,260**
Germany	24	29	18	21	**92**	$84,661	$100,230	$60,000	$66,330	**$311,221**
Israel		2			**2**		$7,375			**$7,375**
Italy	1	1	1	1	**4**	$3,650	$3,000	$2,800	$3,460	**$12,910**
Norway	1		1		**2**	$2,710		$2,800		**$5,510**
Romania			1		**1**			$3,990		**$3,990**
Russia		1	1		**2**		$4,725	$3,900		**$8,625**
Sweden	1	1		2	**4**	$3,500	$5,200		$6,800	**$15,500**
Switzerland			1		**1**			$5,000		**$5,000**
The Netherlands	1	2		1	**4**	$3,850	$7,425		$3,000	**$14,275**
United Kingdom	10	7	7	7	**31**	$34,300	$19,080	$20,960	$24,600	**$98,940**
Sub-Total Europe	**40**	**46**	**38**	**36**	**160**	**$139,471**	**$157,800**	**$124,320**	**$117,190**	**$538,781**
Other:										
South Africa		1			**1**		$2,000			**$2,000**
Sub-Total Other		**1**			**1**		$2,000			**$2,000**
TOTAL	***75***	***103***	***83***	***87***	***348***	***$253,216***	***$329,960***	***$258,600***	***$265,320***	***$1,107,096***

APPENDIX X

International Scientific Union and Subscriptions

Scientific Union	Abbr.	2002 Subscription
International Council for Science	ICSU	$7,985
International Association of Geochemistry and Cosmochemistry	IAGC	-
Asian Crystallographic Association	AsCA	$144
Federation of Asian Scientific Academies and Societies	FASAS	$1,114
International Astronomy Union	IAU	$4,418
International Commission for Optics	ICO	$334
International Geosphere-Biosphere Programme	IGBP	$2,229
International Geographic Union	IGU	$1,672
International Mineralogical Association	IMA	$134
International Mathematical Union	IMU	$1,670
International Union for Quaternary Research	INQUA	$936
International Palaeontological Association	IPA	$67
International Union of Biochemistry & Molecular Biology	IUBMB	$2,229
International Union of Biological Sciences	IUBS	$4,450
International Union of Crystallography	IUCr	$1,391
International Union of Geodesy & Geophysics	IUGG	$3,187
International Union of Geological Sciences	IUGS	$3,922
International Union of Microbiological Societies	IUMS	$1,391
International Union of Nutritional Sciences	IUNS	$1,114
International Union for Pure & Applied Biophysics	IUPAB	$2,140
International Union for Pure & Applied Chemistry	IUPAC	$7,488
International Union for Pure & Applied Physics	IUPAP	$3,298
International Union for Physiological Sciences	IUPS	$2,906
International Union of Theoretical & Applied Mechanics	IUTAM	$1,431
Scientific Committee on Antarctic Research	SCAR	$24,515
Scientific Committee on Problems of the Environment	SCOPE	$4,457
Scientific Committee on Oceanic Research	SCOR	$4,067
Scientific Committee on Solar-Terrestrial Physics	SCOSTEP	$891
International Union of Radio Science	URSI	$1,732
		$91,312

APPENDIX XI

International Financial Support

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

- Dr Tim Moore, CRL Energy, to attend the International Annual Meeting of the Society for Organic Petrology in Houston, Texas, USA during March 2002;
- Mrs Patsy Watson, Massey University, to attend the International Union of Nutritional Sciences General Assembly in Vienna, Austria during April 2002;
- Professor Kip Powell, FRSNZ, University of Canterbury, to attend an International Union for Pure and Applied Chemistry meeting in Brisbane, Australia during May 2002;
- Dr Gerald Tannock, University of Otago, to attend the International Union of Microbiological Societies in Paris, France during July 2002;
- Dr Fred Davey, FRSNZ, GNS, to attend the Scientific Committee on Antarctic Research General Assembly in Shanghai, China during July 2002;
- Dr Jill Stanley, HortResearch, to attend the International Horticultural Congress in Toronto, Canada during August 2002;
- Professor George Clark, University of Auckland, to attend the International Union of Crystallography General Assembly in Geneva, Switzerland during August 2002;
- Professor Rob Goldblatt, FRSNZ, Victoria University of Wellington, to attend the International Mathematical Union General Assembly in Beijing, China during August 2002;
- Professor John Harvey, FRSNZ, University of Auckland to attend the International Union for Pure and Applied Physics General Assembly in Berlin, Germany during September 2002;
- Dr Neil Thomson, University of Otago, to attend the International Union of Radio Science General Assembly in Berlin, Germany during September 2002.

APPENDIX XII

Seed Funding to International Symposia/Workshops

Financial assistance has been provided to the following:

- UV Radiation and Its Effects Workshop held in Christchurch in March 2002;
- Symposium on NZ-France Collaborative Research in Geosciences held in Wellington in July 2002;
- NZ Energy Conference to be held in Wellington during October 2002;
- 7th International Conference on Southern Hemisphere Meteorology and Oceanography to be held in Wellington during March 2003.

APPENDIX XIII

International Visitors

International visitors to the Society during the reporting period included:

- Dr Tom Pringle, Science Communicator from the United Kingdom
- Mr Feng Xuan, First Secretary, Science & Technology, Embassy of Peoples' Republic of China
- Mrs Aldyth Holmes, Director of the National Research Council, Canada Research Press, Canada
- Yasmin Ahmed, Country Manager, Thomson Press (India) Limited, India
- Suzanne Clarke, Manager of Science, Melbourne Girls' College, Victoria, Australia
- Professor Arie Rip, Professor and Head of Department, Science & Technology Studies, University of Twente, The Netherlands
- Andrew Stammer Journals Publisher at CSIRO – Melbourne, Australia
- Dr Chung Duk Kim, Chairman and CEO, KOSEF, Mr Byung Whan Ho, Head of International Programs, KOSEF, Mr Pil Koo Kang, Chief Specialist, KOSEF
- Zhang Xiaohu, Beijing Association for Science & Technology, Peoples' Republic of China
- Karen O'Connell, Manager, Human Resources, Royal Society (London)
- Her Excellency Mrs Ruth Kahanoff, Ambassador, Embassy of Israel
- Gwen Pilling, University of York, United Kingdom
- Sarah Flannery, Young Scientist of the Year, Ireland
- Dr Jilly Evans, Merck, Sharpe and Dohme Researcher, USA
- Dr John Ellis, Dr Diether Blechschmidt, Dr David Krofcheck, Dr Alick Macpherson of CERN, and the NZPIXELS project
- Dr Mahmood Amani Tehrani and Dr Hossein Daneshfar, Ministry of Education, Iran
- Mrs Maureen Manchouck, Trinidad's Research Agency, Trinidad
- Deputy Vice Chancellor, Hawaii University, USA
- Tim Radford, Science Editor, Guardian, UK
- Robert Lord May FRS, President, Royal Society (London), UK
- Professor Alan MacDiarmid ONZ Hon FRSNZ, Blanchard Professor of Chemistry, University of Pennsylvania, Philadelphia, USA
- Sir William Pickering Hon KBE Hon FRSNZ, President, Lignetics Incorporated, California, USA
- Professor Michael Kelly FRS FREng Hon FRSNZ, School of electronic Engineering, University of Surrey, Guildford, UK
- Fred Spilhaus, Executive Director, American Geophysical Union, USA

APPENDIX XIV

2001/02 Contestable Science and Technology Promotion Fund Recipients

The following projects have received funding from the 2001/2002 round.

Up to $100,000 (including GST)

A Minute of Science

Livingstone Productions Ltd
Project leaders: John Givens and Tim Marshall

"A Minute of Science" will be a series of one minute long television programmes about innovative science discoveries in New Zealand. This is a joint venture with Television New Zealand and Channel 1 and will run nightly in prime time on TV1. The one-minute format is specifically intended to give a short, snappy byte of current scientific research happening in New Zealand. It will be a highly charged show that is stimulating, informative and entertaining, and will be talked about in the workplace and classroom the following day.

Present status: Originally scheduled to air at 6pm on TV1 in April 2002, this project has suffered several delays due to sponsorship uncertainties. Ten topics have been researched thoroughly, and Livingstone Productions has completed four two-minute programmes that aired on the Saturday morning programme “Knowledge Breakfast” in July 2002. Negotiations are presently underway with potential sponsors to have 1-minute versions of these programmes aired on primetime TV in the New Year as part of the “Innovation Minutes” series.

Up to $30,000 (including GST)

Aotearoa: A Journey of Discovery

He Kupenga Hao i te Reo Inc. (2 years)
Project leaders: Ian Christensen and Eljon Fitzgerald

This Palmerston North based project will develop a bilingual (Maori and English) board game that provides knowledge, information and understanding of science, technology, mathematical and social science phenomena in a contemporary and historical New Zealand context. “Aotearoa: a Journey of Discovery” is targeted at Maori school pupils, but will have widespread appeal to all age groups and the themes featured in the game are of relevance to all sectors of society.

Present status:
This is a two-year project and is making excellent progress. Research for the board game has been completed with 25 locations identified for inclusion, questions developed from information gathered at each location and photographs taken or obtained from information centres and tourist attractions. Negotiations are in place with the graphic designers to design and build the board game.

Science and Technology- Partners in Regional Development

Institute of Professional Engineers New Zealand Inc. and Business New Zealand Inc.
Project leaders: John Gardiner and Simon Carlaw

“Science and Technology- Partners in Regional Development” will be a series of regional forums designed to promote the value of science and technology to small and medium sized businesses. Attendees will go away from the forum understanding its critical role in wealth creation and what they, as local community leaders, can do to encourage and use science and technology based innovation and entrepreneurship to develop a stronger economy and society.

Present status:
Project completed on time and within budget. 1100 small and medium business owners attended 22 forums that were held around the country. The presentations focused on the critical role science and technology has for business success and wealth creation and the feedback from local media and audiences was excellent. Several regions used the Roadshow as part of their community consultation process for developing their regional economic development plans.

The Language of our Rocks

University of Canterbury
Project leader: Richard Hartshorn

"The Language of our Rocks" aims to equip secondary school science teachers throughout the South Island with the necessary skills to teach Earth Sciences with confidence. Many teachers feel insecure when dealing with this part of the curriculum, as they are primarily qualified in chemistry, physics or biology.
The programme will include workshops, assistance with field trips, and a rock exchange will be established between participating schools.

Present status:
Project completed. Feedback from the initial participants was so positive that there was an overwhelming number of applicants from all over the South Island, and an extra workshop was scheduled to cope with the numbers (107 in total). Rock identification kits were compiled and distributed, and ongoing assistance will be provided.

Mathematics Promotion in Manukau

University of Auckland Mathematics Education Unit
Project leader: Bill Barton

The Mathematics Promotion in Manukau Project is an initiative aimed at raising awareness of the importance and relevance of mathematical science in the Manukau community. By working with business and professional role models from within the community, this project will awaken people to the way in which mathematics and statistics underlie activities such as planning, organisation, distribution and many community services.

Present status:
Funding for this project was sought jointly from the Science and Technology Promotion Fund and the Manukau City Council. Although the funding from the Promotion Fund was finalised in November 2001, the Manukau City Council has only recently agreed to the matching funding. The project will commence shortly.

Taking it to the Streets

Auckland Museum Institute
Project leader: Hugh Grenfell

The "Taking it to the Streets" project involves using young science and technology graduates as street theatre performers who go to the audience rather than the audience coming to them. Based in South Auckland venues such as marae, shopping malls, and libraries, this format will be an effective way of communicating science-related issues in ways the audience can relate to in their everyday lives.

Present status:
Project completed. The science shows were developed using a mix of science graduates and student actors, with 24 performances overall. Monitoring showed there was an excellent response within South Auckland shopping malls with over a hundred spectators at each show, and excellent audience attraction and retention.

E ruia mai nga kakano o putaiao me hangarau – Planting the Seeds of Science and Technology: An Otago Maori Community Initiative

University of Otago Maori Post-Graduate Students Association
Project leader: Mark Laws

This project will host a series of science and technology awareness camps (hui and wananga) designed specifically for Maori based in the greater Dunedin area. The emphasis is marae-based, and will present science and technology in a positive non-intrusive manner to audiences ranging from children to parents and grandparents.

Present status:

Project completed. Over 200 people of Maori descent participated in and around the hui, which was held over two consecutive weekends at Te Kura Kaupapa Maori o Otepoti in late November and early December 2001. Several small research clusters were formed to highlight to the participants the benefits of scientific research and knowledge. After the completion of the project, many visitors said that this event and the wananga would be remembered because it maintained the essence of Maoritanga throughout the entire period, even though science and technology was always the focus and the underlying theme.

Floating Love and Passion in the Scientific Imagination- An Archive of Contemporary Culture

Massey University, Wellington
Project leader: Anne Noble

This is a documentary photographic and life history project, in which a combination of visual images and spoken word will be used to challenge popular conceptions of what it means to be a scientist. Whereas scientists and technologists are usually portrayed in close proximity to laboratory equipment, this project will convey images of scientists in the context of conversations about love, passion and the scientific imagination to a wide audience.

Present status:
Project on schedule for completion in December 2002. Photo essays have been produced for 30 scientists from the Wellington region. Oral histories have also been recorded for each person portrayed. The scientists report that they enjoyed their participation in this project and the results are an impressive array of thoughts and images that definitely challenge the stereotype of scientists being boring, dispassionate people. A launch event will be held in November 2002.

Sounds Fun

Hawkes Bay Cultural Trust- The Faraday Centre (2 years)
Project leader: Anthony Prebensen

“Sounds Fun” is an interactive exhibition about the physical phenomena of sound. Specialist equipment will be restored or designed to provide educators with an excellent teaching resource based in Napier. Children will interact with the equipment and adults in an enjoyable and informative way that promotes positive responses and comments. The first year of the project will include the generation, recording and transmission of sound, and the second year will concentrate on frequencies and uses.

Present status:
This two-year project on schedule for completion in 2003. The initial phase of the exhibition opened in May 2002 and 1928 children and 576 adults have attended so far. The equipment and experiments are simple, yet extremely effective in gaining the children’s attention and explaining everyday phenomena. There has been very positive feedback from children, teachers and the media.

Porirua Secondary Schools Mentoring Initiative

Partners Porirua
Project leader: Michelle Robinson

This project will enhance the experiences of Maori and Pacific Island secondary school students in the Porirua area, and help them reach their full potential in the areas of science, mathematics and technology. University students who act as mentors will provide one on one support. These mentors assist with activities, lifting the pupils’ expectations and increasing their knowledge about science and technology research, its applications, and how it relates to every day life.

Present status:
The programme has commenced at Mana and Bishop Viard Colleges, and will expand into Porirua College commencing term 3. Approximately 67 year 10 and 23 Year 11 students (75% MPN) are currently participating, with 24 mentors from Te Ropu Awhina Putaiao at Victoria University assisting. Initial monitoring of this project shows that there are great benefits for both the students and the mentors, and that the advantages will carry over into future years of education. The individual aspirations of each student have been raised, their confidence increased and the goal of a university education is no longer an impossibility. Funding through the Science and Technology Fund will cease

in December 2002 although the project will be ongoing provided additional support can be obtained from other sources.

SciTech Trends – 21st Century

Science Alive! The New Zealand Science Centre
Project leader: Brian Taylor

"SciTech Trends – 21st Century" is a set of 8 interactive mobile units which focus on a number of science and technology issues which have an impact on our future as New Zealanders. These exhibits will be designed to encourage business people who are decision-makers to think about and discuss the issues raised by them. The units will be placed on display at seminars, workshops and business planning meetings in the Christchurch area where participants can interact with them during breaks.

Present status:
The project is scheduled for completion in November 2002. A large amount of research was needed to ensure the accuracy and suitability of the displays for adults. This delayed the construction process slightly but the exhibits are now being built and the venues are being allocated.

New Zealand in Time and Place

New Zealand Historic Places Trust
Project leader: Jan Titus

"New Zealand in Time and Place" will be a video illustrating the role of Lyttleton's Timeball Station in navigation around New Zealand. It will explain the underlying concepts behind navigation and longitude from Victorian technology through to GPS, under the central theme of 'knowing where you are is a matter of knowing what time it is.' Situated at the Timeball Station museum in Lyttleton, this video will inform and entertain many school groups and overseas visitors.

Present status:
The project is scheduled for completion in October 2002. The video is in the final stages of production and is of exceptional quality. A longer length version will be produced for use in schools.

APPENDIX XV

RSNZ Publishing - *a case for the national research journals*

Issue:

The Royal Society has been asked to present a case to government in consideration of the seven learned journals currently published by the Society. In essence, the Ministry of Research, Science and Technology has asked for our views on three questions:

- Why do we need New Zealand based research journals?
- What journals does New Zealand need? What is our competitive advantage in the international market?
- What sort of quality, in terms of scientific impact, will the journals have?"

MoRST has asked the Society for a reply on these questions, to accompany the Progress and Achievements Report, in time for consideration for funding from July 2003.

Background:

The Society was asked to take on a publishing role from DSIR in 1991, with partial assistance from government subsidy, which has remained unchanged since that time. Since 1991, inflation has risen by some 33%. Meanwhile, journal prices have continued to be squeezed over the decade, as they were hit by libraries' and other subscribers' ability to pay. As a result, the Society has gradually reduced its publishing resources while at the same time has instigated changes to enhance the overall performance of the journals. The New Zealand science and technology (S&T) journals specialise in results from regional research. Their specialist content is the very reason for the journals' existence. The Society is committed to continue providing high-quality, well-cited, national S&T journals with good and established international reputations. After several years of suspension, new Editorial Boards have been established to assist in the process of formulating strategies for the successful future of each journal. With their help, and with the support of the New Zealand S&T community on whose behalf the journals are published, the Society is confident that the journals will remain as leading flagships for the dissemination of the results of New Zealand's scientific and technological endeavours.

A CASE FOR NEW ZEALAND'S NATIONAL S&T JOURNALS

1. DOES NEW ZEALAND NEED TO PUBLISH NATIONAL RESEARCH JOURNALS?

Countries of the world need to make their expertise and capabilities in S&T research and development visible in the international arena. National journals play an integral role in this. For New Zealand S&T to be seen as credible by world standards it must continue to publish national research journals in the areas in which it has strengths and capability.

There is no substitute for New Zealand's own journals for publishing the results of New Zealand's research. Our national research journals are part of the global journal infrastructure of S&T publishing and ensure our presence in the international S&T scene. New Zealand's national journals need to be at the forefront of international S&T publishing to enhance New Zealand's scientific reputation in the world.

"New Zealand's national science journals make our research more credible, raise the profile of New Zealand and New Zealanders, and assist to create economic opportunities." (Government researcher, New Zealand).

"If New Zealand intends to be a player in international science it has an obligation to contribute to the production of journals to make the information available. Publication is an integral part of the scientific

process. If we don't provide publication outlets then we have a decidedly third world attitude." (Journal Editorial Advisory Board member, New Zealand)

"New Zealand based journals are part of the New Zealand science infrastructure. The reason for their existence is the same as it has always been and nothing has changed externally to give any reason to drop them". (Journal Editorial Advisory Board member, New Zealand)

In 1991, after wide consultation with the scientific community, officials from the former DSIR and MoRST found that publication of New Zealand journals was justified on the following grounds:

- the journals maintain scientific self respect
- they complete the scientific process
- they are a clear measure of productivity
- they have a profound influence on the quality of research done in their fields
- they promote a sense of community in the scientific sense
- they preserve knowledge
- they provide a vehicle for publishing research primarily of regional interest and value
- they represent a time investment
- the cost of their publication is trivial in comparison to the cost of undertaking the research

As a result of these findings, Cabinet noted that:
"… journal publication is an important part of the science infrastructure which provides for communicating scientific results within the scientific community, maintaining scientific knowledge and quality, and is an integral part of the continuum of science."

New Zealand's national research journals continue to have an integral role by assessing, documenting, disseminating, and promoting the results of New Zealand's S&T research, in printed and electronic form, to the benefit of others and to complete the investment made in the research. In doing so, they promote New Zealand's S&T research to the New Zealand and international community by:

- facilitating international linkages through the sharing and using of new knowledge;
- advancing New Zealand research by fostering contact between researchers in similar fields; and
- encouraging the flow of knowledge, skills, and ideas into New Zealand's research and innovation system.

Therefore, national journals forge international links that connect New Zealand to the best of international research as well as promote New Zealand's research capacity to the international S&T community.

"If we are to foster the "knowledge" economy then we must certainly have New Zealand-based science journals." (Journal Editorial Advisory Board member, New Zealand)

Our national journals are primarily devoted to New Zealand's national S&T research effort and encompass regional (eg. Southern Hemisphere, South Pacific, Australasia, Antarctica) and indigenous research as well as publish knowledge and technologies of worldwide relevance and significance. They are considered to be "essential" and "fill a valuable niche" as they are indispensable for the publication of local S&T which may not be seen to be relevant to international journals that target their own regional audience or a broad readership.

"High quality New Zealand journals are an important way of bringing New Zealand science to a wider audience. This is true both of new high-profile articles, but also of those that provide the important basic science that may be the foundation of new international research initiatives." (Journal Advisory Board member, United Kingdom)

National research journals offer a means of publication for New Zealand researchers in a readily identified product. New Zealand researchers consider that national journals are important for their relevance to New Zealand or regional work. Many researchers are required by their FRST contracts to publish the research where it will be available to the end-users, and the national journals fulfil this function. The national journals are also the storehouse of knowledge specific to New Zealand. International readers also appreciate access to detailed results published in a local journal that would not be of interest to other journals. In addition, national journals present New Zealand perspectives on international research issues.

"The New Zealand-based journals are ideal for publishing data of relevance primarily to the New Zealand situation … The journal series are an extremely valuable record of such work, containing refereed reliable data." (President, New Zealand scientific society)

"…scientists use this journal [New Zealand Journal of Marine and Freshwater Research] *as an output for their FRST work so it's kept in the New Zealand domain."* (New Zealand researcher).

"I strongly support the existence of regional (but with worldwide distribution as NZJMFR) journals of this type." (European researcher)

If New Zealand did not have its own regional journals, this research they contain would most likely be lost or at least inaccessible to others. Such research results would therefore be ineffectual and represent wasted resources. Most of New Zealand's research is publicly funded and the public has the right to require that the results be adequately published and freely available. After all, it is the people of New Zealand, now and in the future, that will ultimately benefit.

"Of course we need New Zealand-based science journals otherwise there will be no focus for refereed scientifically credible work that applies to the unique conditions pertaining to this country. New Zealand science needs its own identity and not be thought of as a subset of Australian science or a meagre contribution tacked on to European or American science vehicles." (Journal Advisory Board member, New Zealand)

"New Zealand needs a high quality publication venue for research for the New Zealand audience. This is the only way we can guarantee publication of New Zealand-funded research. And this is the most cost efficient way to transfer this information to those who can influence and effect change." (President, New Zealand scientific society)

No other journals can provide the promotion and prestige of New Zealand research to the world than New Zealand's own national research journals. Our national research journals are flagships for New Zealand S&T internationally.

2. WHAT JOURNALS DOES NEW ZEALAND NEED? WHAT IS OUR COMPETITIVE ADVANTAGE IN THE INTERNATIONAL MARKET?

2.1 What journals does New Zealand need?

Science and technology that is uniquely relevant to New Zealand needs New Zealand journals. The biological, aquatic, earth, primary production, and social sciences are of greatest relevance to New Zealand and are where New Zealand's main research efforts are focused. Concentration of New Zealand S&T in New Zealand journals allows easy access to the knowledge for people all over the world, and illustrates to the rest of the world the nature and quality of New Zealand science, New Zealand scientists, and the biota and land themselves. Each of the New Zealand national S&T journals is a unique entity. Each specialises in a particular academic discipline (subject area) and a specific geographic region; thus, each serves a specific section of the S&T community. Each is a national asset as a storehouse of the collective knowledge that has been generated mainly in and about New Zealand.

Various Editorial Advisory Board members have noted:

"There is a New Zealand-based science effort that studies things of primary interest and use in the New Zealand context, and it is essential that this continues to be done here. We do not want our literature totally at the whim of international trends and editors."

"Science that deals with wider and more universal subjects (eg. chemistry, physics, mathematics) is by its nature international. The unique aspects of New Zealand (its biology, for example) are of prime local relevance."

"We need a range of journals covering the geological, marine, and biological sciences. One could argue the need for a broad environmental journal as well."

"We certainly need a primary production research journal … cover all research into the farming of plants and animals."

2.1.1 Natural sciences

New Zealand has a unique biota that inhabits a unique landmass, both of which are still being explored, documented, and investigated. Within New Zealand, research on New Zealand natural history and the natural environment informs teachers and students at all levels, other scientists, local government, users of the natural environment, national and local natural heritage conservation, tourism, and a wide range of industries. The primary overseas audiences are teachers, students, and scientists.

"We [Natural History New Zealand] *recognise the critical importance of academic research in unravelling the stories of our planet which organisations like ours can then build into documentary and non-fiction works for a wide audience."*

New Zealand currently has four national S&T journals which specialise in aspects of the natural environment and biota:

New Zealand Journal of Botany (first published 1963) specialises in all aspects of botany, plus mycology (fungi) and phycology (algae), of the South Pacific, Australia, South America, southern Africa, and Antarctica. The geographic specialisation reflects the ancient connections of the New Zealand flora with those of former parts of the supercontinent of Gondwana. For the last 40 years, nearly all of the New Zealand plants (and many fungi and algae) which have been described and named as new to science have been published in *New Zealand Journal of Botany*. The Department of Conservation requires a rare plant to have been formally described and named before any conservation work on it is undertaken. *New Zealand Journal of Botany* is internationally recognised as the primary site of publication of new plants from New Zealand, by botanists worldwide and by the International Association of Plant Taxonomists which governs the global rules of naming new plants.

"The New Zealand flora is self-contained; in the New Zealand Journal of Botany *we have the compendium of information that goes with it."*

"Other countries expect that New Zealand's new species are published in a New Zealand journal in the same way as their new species get published in their journals."

"New Zealand Journal of Botany *provides a high quality venue for the publication of research of New Zealand's unique flora."*

New Zealand Journal of Zoology (first published 1974) specialises in all fields of zoological science concerning New Zealand, the Pacific Basin, and Antarctica. Particular strengths are insect taxonomy and pest control, reflecting the diversity of the native fauna and the effects of introduced animals on the native biota.

"Descriptive work on New Zealand flora, fauna, and ecology is unlikely to be published internationally but is immensely important to New Zealand's knowledge of its own biological estate and native biodiversity."

"If I published a description of a New Zealand skink in e.g. the Dutch Journal of Herpetology*, that might be considered an international publication but it certainly would not be a service to the advancement of science in New Zealand—rather the opposite."* (Journal Editorial Advisory Board member, New Zealand)

New Zealand Journal of Marine and Freshwater Research (first published 1967) publishes research in all fields of fisheries and aquatic science relevant to Australasia, the Pacific Ocean, and Antarctica for researchers and resource managers in research institutions, universities, museums, regional authorities, and other centres. The scope includes genetics, limnology, marine ecology, physical oceanography, physiology, sedimentology, stream ecology, taxonomy, and water quality studies.

"New Zealand Journal of Marine and Freshwater Research *provides scientists with a high quality journal of international standard in which to present their research to both their national and international peers."*

"An international journal with high ranking publishing and a great representation of different aspects of aquatic research."

New Zealand Journal of Geology and Geophysics (first published 1958) specialises in all aspects of the Earth sciences relevant to New Zealand, the Pacific Rim, and Antarctica. Its role is to make Earth science research and processes in the New Zealand region accessible and applicable to geoscientists everywhere whose interests lie within and beyond the circumpacific area.

"I frequently turn to the New Zealand Journal of Geology and Geophysics *to continue my ongoing education in continental evolution."* (International geoscientist)

Knowledge published here also has practical relevance to natural hazard preparedness and to commercial prospecting and mineral extraction.

"Some of your geology is hazardous, and so New Zealand benefits societally from international collaborative research, and the international community also benefits from, for example, a better understanding of your active volcanoes." (International Editorial Advisory Board member)

These four journals plus the *Journal of the Royal Society of New Zealand* are the successors to the publication that was New Zealand's only national S&T journal from 1869 (*Transactions and Proceedings of the New Zealand Institute*, 1869–1933; *Transactions and Proceedings of the Royal Society of New Zealand*, 1933–58; *Transactions of the Royal Society of New Zealand*, 1958–71). *Journal of the Royal Society of New Zealand* has been published since 1971. It is a natural history journal of New Zealand and the Pacific region, including Antarctica, with particular strengths in palaeobiology (fossils) and palaeoecology (ancient environments), animal taxonomy, and interdisciplinary topics. This journal complements and supports the above four national journals, particularly so since all have been published by the Royal Society of New Zealand. Extra-long animal taxonomy papers, interdisciplinary papers that go beyond the scope of a single-discipline journal, and (on occasion) an over-supply of papers to one or more of the above four journals are all published in *Journal of the Royal Society of New Zealand*.

2.1.2 Primary production

New Zealand's national income is largely land-based, from the production of food and fibre, tourism, and mineral extraction and processing. New Zealand has two national primary production journals concerning food and fibre production and the related natural environments. The S&T in these journals informs teachers and students at all levels, practitioners (farmers and horticulturalists) and their advisors, local government, and relevant industries.

New Zealand Journal of Agricultural Research (first published 1958) specialises in all aspects of temperate and subtropical pastoral agriculture; that is, animals that are farmed for food and/or fibre, production and quality of the food they eat, their health and welfare, the environment in which they live, and product quality. Of increasing concern and research effort is the effect of such farming on the natural environment (methane emission, contamination of waterways).

"It is imperative that we have a national agricultural journal helping to underpin knowledge and technological developments in this sector."

"Most developed countries publish their own agricultural research journals."

New Zealand Journal of Crop and Horticultural Science (first published 1989, continuing *New Zealand Journal of Experimental Agriculture* (1973–88)) publishes research on temperate plant biosciences covering all aspects of production, protection, handling, and processing of crop and horticultural products. It is published for researchers in research institutes, universities, other centres, and industry. The scope includes agronomy, entomology, breeding, plant pathology, pomology, postharvest physiology, and biotechnology.

Various users of the journal have said:
"New Zealand Journal of Crop and Horticultural Science *is a high quality journal which plays an important role in presenting crop and horticultural research, from both New Zealand and the wider Pacific region, to the international research community."*

"…fulfils a critical role within the primary industry-based research community in New Zealand. The quality of the current papers is high and of broad interest."

"…is a quality publication that is widely read by horticultural crop researchers worldwide."

The applied S&T that is published in both of these journals is informed and supported by the five natural sciences journals published by Royal Society of New Zealand.

2.1.3 The need for other journals

There is no national Soil Science journal in New Zealand. Much of the primary information about New Zealand soils is contained in DSIR Soil Bureau Bulletins. New Zealand soil science that is particularly relevant to agriculture or horticulture may be published in *New Zealand Journal of Agricultural Research*, *New Zealand Journal of Crop and Horticultural Science*, or *Journal of the Royal Society of New Zealand.* Other New Zealand soil science is published mainly in *Australian Journal of Soil Research* and occasionally in *New Zealand Journal of Geology and Geophysics.*

There is an acknowledged need for a new national journal of social science in New Zealand. At present much social science research done in New Zealand is reported in unpublished contract reports to government agencies or is partially presented in chapters of books or in conference proceedings. A national journal would improve the accessibility and preservation of New Zealand social science knowledge for users in New Zealand and overseas.
"*It is envisaged that such a journal would include both New Zealand and international material, but have a focus on the New Zealand context. It would give priority to publication of articles that reported on the work of interdisciplinary research teams.*" (Royal Society of New Zealand Social Science Committee)

2.2 What is our competitive advantage in the international market?

The New Zealand national S&T journals exist to make available, to New Zealand end users and to the world at large, past and current knowledge that is generated mainly in New Zealand by mainly New Zealand researchers who are funded mainly in New Zealand. Use of the word “competitive” is irrelevant in this context. The international advantage of publishing New Zealand S&T journals is that anyone anywhere in the world who wants to know about New Zealand natural or primary production sciences and New Zealand’s researchers has a clearly labelled, recognisable source to consult. New Zealand has been, still is, and will continue to be a recognised world leader in many areas of S&T research. Examples include: the breeding and growth of pasture grasses and clovers; plant breeding and production of kiwifruit; research on earthquakes, volcanoes, and geological and aquatic hazards; the systematics, taxonomy, and conservation of our entire native biota, terrestrial and aquatic; management and control of introduced plant and animal pest species; the geological history of our natural environment and biota; environmental management.

"Scientific research should be published for its own sake and value."

"Only out of a sound body of national research will work of international significance emerge."

"All of the New Zealand science journals publish scientifically sound articles that contribute to knowledge and understanding internationally."

"It’s a strange form of lack of confidence when all research has to be ranked on an international scale. North Americans and Europeans have a number of very high quality regional journals that are very specifically and confidently regional; their quality and repute is never questioned simply on the basis that they are regional in focus."

Additional international advantages held by the New Zealand national journals are the engagement of permanent, salaried editors, and the use of non-New Zealand referees. Having papers reviewed by experts outside of New Zealand has a double benefit: as well as endeavouring to provide the best possible expert quality control of the S&T being published, it is a means of increasing global awareness of New Zealand S&T.

"We have a rigorous system for evaluating papers submitted for consideration for publication."

Many journals produced overseas use volunteer editors who have full-time academic or research positions but, sometimes for a small honorarium, manage a journal for three or five years before the position is handed on to someone else. Some journals appoint editors on contracts of a few years. The permanent salaried editors employed by the Royal Society of New Zealand are committed to the journals they work for and the communities they serve. This personal engagement of an editor in the life, value, and quality of the journal is coupled with the independent status of being a non-practising scientist working in a non-research organisation. Thus, the New Zealand national S&T journals, and the communities they serve, are assured of long-term commitment and integrity of the editors.

"Editorial control/refereeing seems good and has the feel of publishing information that one can trust". (researcher, United Kingdom)

"The refereeing of submitted papers by New Zealand and international experts is rigorous and meticulous."

"…an excellent refereeing system and a very good scientific editor."

The editors of the national journals can only further the interests and development of the journals if most New Zealand S&T can continue to be published in the journals. This requires commitment and support from central government. New Zealand researchers must not be prevented from publishing in New Zealand's national journals. Research that has been publicly funded must be published in New Zealand at public cost and thus be available to New Zealand end users as required by the public funding system. If central government will not financially support the national journals to provide adequate staffing and ongoing development, and publication at no cost to authors, New Zealand research will be published offshore or not at all. New Zealand's knowledge heritage would then become lost to New Zealand, lose its identity, and be largely unnoticed in the global mass of information.

3. WHAT SORT OF QUALITY, IN TERMS OF SCIENTIFIC IMPACT, WILL THE JOURNALS HAVE?

3.1 How do you measure the scientific worth of a New Zealand journal?

Some accepted criteria for measuring scientific quality and impact of research journals are:

- reputation
- journal profile in the S&T community
- quality of papers submitted
- quantity of papers submitted
- citation ratings
- standing of researchers associated with the journals
- availability of alternatives
- financial support

3.1.1 Reputation of the journals – publication history

All national journals published by the Royal Society have established reputations, both nationally and internationally, built upon the quality of the research that they publish and the integrity of the papers themselves. Of the current suite of journals, *Agricultural Research* and *Geology and Geophysics* have been published for 45 years, *Botany* for 40 years, *Marine and Freshwater Research* for 36 years, *Crop and Horticultural Science* (including its predecessor) for 30 years, and *Zoology* for 29 years. From the most recent review of the journals (1995/96) designed to assess potential for rationalisation of the titles published, the consensus opinion (82%) was of continuing support for the current suite of journals. The continuity of these titles was, and is, considered important.

"*It is important to have a hierarchy of publications available to researchers, and these 7 journals fill the top echelon…*" (President, New Zealand scientific society)

3.1.2 Journal profile — catering to the needs of the S&T community

There is strong support from the S&T community in New Zealand and overseas for the continuation of New Zealand S&T journals in which to publish mainly regional science. A 2000 opinion survey carried out by the editors at the Royal Society (96 respondents) indicated that the New Zealand journals were the preferred choice for researchers publishing New Zealand research. This reinforced the opinions arising from the 1995/96 review. The quality of the journals was considered to be as good as, or

better than, many larger "prestigious" international journals. Having "New Zealand" in the title identifies both the strength and purpose of the journal and its relevance to the whole S&T community.

"Only out of a sound body of national research will work of international significance emerge that can then legitimately be published in international journals."

"*New Zealand needs a high quality publication venue for research for the New Zealand audience. This is the only way we can guarantee publication of New Zealand funded research. And this is the most cost efficient way to transfer this information to those who can influence and effect change."* (President, New Zealand scientific society)

The journals are distributed worldwide. They help in MoRST's stated goal to "...promote New Zealand's research capacity abroad". As one international geoscientist observed:

"Your journal [NZJGG] *is one of the most important in terms of my work because, under one cover, it gathers a wide range of Earth science subjects vital to a better, more thoroughly integrated understanding of how continents evolve."*

And another:

"*We have senior faculty at our university* [University of California] *who use the geology of the country for funded research on problems of broad issue. Yet this is only possible because of earlier work often published locally in New Zealand."*

3.1.3 Quality of papers submitted – peer review, quality of the science

The journals publish the results of the national research effort. Most of New Zealand's publicly funded research is critically assessed and approved prior to allocation of the funding. If it is accepted that New Zealand research is of the best scientific standards according to international criteria, it follows that publication of that research in the preferred New Zealand journals will be of similar standards in terms of scientific integrity and rigour. All the New Zealand journals have strict procedures for assessment and accreditation of the papers that they publish. Initial submissions are reviewed by colleagues as a prerequisite to their submission to a journal. Subsequently, papers are sent to two or more reviewers to assess their scientific validity. At least 50% (on some journals up to 70%) of all reviewers are from outside New Zealand, ensuring that there is reduced risk of bias or familiarity unduly influencing the assessment. The journals themselves are edited by experienced, professional, S&T editors who have good judgment and a non-compromising attitude towards quality in terms of both scientific content and presentation. The result is a product that provides a body of significant knowledge to New Zealanders and is a showcase to the international S&T community.

"I have published on occasion in journals in the USA, UK, Germany and Australia, and the New Zealand journals have equal or higher standards of reviewing and certainly equal quality of final product."

3.1.4 Number of submissions

One level of support for a journal is seen in the number of papers authors choose to submit to it for publication. In total, the average number of submissions between the years 1990-95 and 1996-2001 has remained at the same level, though some journals have shown increases (eg. *Botany*, *Marine and Freshwater Research*) while others have decreased (eg. *Agricultural Research*, *Crop and Horticultural Science*). These variations reflect the changing patterns of research effort or priorities of publicly funded S&T. As a country, New Zealand is steadily increasing its S&T publications (as a percent of the world average) as its international collaboration in S&T publications is also steadily increasing. Considering the growing number of journals worldwide, and the increase in S&T publishing generally over time, it is clear that support for the New Zealand journals has remained strong even if options for alternative avenues for publication have increased. The New Zealand journals have also withstood the push by many institutions for authors to submit their work "overseas".

"FRST policy on publications credit has contributed to a decreasing number of publications coming to [the New Zealand journals] *from an increasing total of science publications generated … a more integrated view of this issue across the FRST-MoRST spectrum would be helpful."*

3.1.5 Citation ratings

Citation analysis is a universal measure of a journal's international standing. The impact factor (IF) – the average number of citations per paper – can be compared with the IF of other journals worldwide. However, compared with journals from large countries overseas with wider geographical "regional" extent, its value as a measure of worth for the New Zealand journals is limited, and there are other measures (outlined in this report) of good quality journals than the citation ratings alone.

"International impact should not be a criterion. Science in New Zealand is for the good of New Zealand, not international renown."

Nevertheless, many institutions in New Zealand (and overseas) consider publishing their work only in journals with an IF of 1 or more. This immediately sets an unrealistic target for the New Zealand journals, which simply cannot sustain that level for any period of time because the citing population is just too small. Despite that, the citation ranking of the New Zealand journals is commendably high.

The impact factors of the New Zealand journals have shown significant improvement since records began. For example,

Year	NZJAR	NZJB	NZJCHS	NZJGG	NZJMFR	NZJZ
1985	0.52	0.52	0.22	0.31	0.73	0.17
1986	0.48	0.31	0.31	0.22	0.33	0.12
1987	0.41	0.33	0.10	0.34	0.19	0.22
1988	0.38	0.57	0.17	0.26	0.14	0.29
1996	0.46	0.94	0.29	0.73	0.95	0.63
1997	0.41	0.42	0.30	0.61	0.66	0.56
1998	0.63	0.69	0.12	0.79	1.14	0.5
1999	0.59	1.01	0.27	0.81	1.26	0.47
2000	0.56	0.89	0.23	0.62	0.65	0.68
2001	0.48	0.81	0.43	0.65	0.60	0.58

Of particular significance for the New Zealand journals is that the cited half-life (ie. the average length of time that an article continues to be cited) is typically more than 10 years. This indicates the continuing value and archival relevance of the nature of the work published.

All New Zealand journals published by the Royal Society are analysed by the ISI (Institute for Scientific Information, USA):

Only 5000 journals from a worldwide science journal population of around 25,000 are considered by ISI to be of sufficient standard to be used in their citation analysis. On that basis alone, the New Zealand science journals can be said to be in the top 20% of the world's science journals.

3.1.6 Standing of researchers associated with the journal – authors, referees, editorial board members

Scientists and technologists with established reputations continue to support the New Zealand journals by submitting the results of much of their New Zealand-based research to them. Journal referees (over 500 per year) give of their time and expertise to assist the journals in maintaining their scientific quality and integrity. Editorial Advisory Boards, consisting of people nominated by members of scientific societies and leading organisations, have been formed for all the journals. Board members assist the journals, not only by giving practical advice to the editors on scientific matters and policy affecting journal content and performance, but also by lending credibility to the journals through their considerable knowledge, experience, reputation, and influence and by promoting them worldwide.

3.1.7 Alternatives for users

Most of the papers published in the New Zealand journals report scientific results of relevance only to the New Zealand region. They may or may not have wider relevance. But for those that do not, it can not be assured that other international journals would be prepared to publish them. This is not a reflection of their quality.

"If [the New Zealand journals] *were to cease, there would be no coherent way of widely disseminating scientific results of importance to New Zealand that did not have wider applicability. This would severely damage the body of knowledge about the physical environment and processes of New Zealand."*

With reference to the large "international" journals from the Northern Hemisphere, it is interesting to note that they themselves are largely regional in content also, and therefore often unsuitable avenues for the publication of the results of New Zealand (Southern Hemispheric) research. In the words of an Editorial Advisory Board member:

"All the top 10 journals are hopelessly "Americo-centric"."

3.1.8 Financial support – subscriptions, government subsidy

(i) Number of subscriptions

A worldwide trend for many journals over the last decade has been a decrease in the number of subscriptions. The reasons for this are varied and the decrease does not necessarily reflect a decrease in support for the journals or a perception of decrease in their quality, or even a reduction in the number of readers. Some of the influences on subscriptions to the New Zealand journals are: (1) universal cuts to library budgets – libraries, especially from overseas institutions, constitute the largest proportion of the journal subscriber base; (2) an increase in the availability of "competitive" journals, including the international "must haves", together with the push to publish offshore, has meant that many individual researchers in New Zealand have had to spread their resources more widely – not all researchers subscribe to the New Zealand journals personally, especially when the journal is available in their library, so reliance is placed on the library access; (3) the growth of online publishing has increased the options for journal users, making subscription to the New Zealand journals less necessary.

The bottom line for New Zealand researchers is that the New Zealand journals, as well as most relevant international journals, are now more readily available for their use without the need for an individual subscription. The New Zealand journals themselves are "freely" available online during 2002 to any researcher with electronic access. In effect, though subscription numbers have decreased, the number of real and potential readers of the journals has increased.

(ii) Government subsidy

When the New Zealand science journals published by the DSIR were transferred to the Royal Society in 1991, Government recognised the need for their funding. A Cabinet Committee at the time noted, "…that journal publication is an important part of the science infrastructure which provides for communicating scientific results within the scientific community, maintaining scientific knowledge and quality, and is an integral part of the continuum of science" and "… the benefits of scientific publication extend beyond the immediate interests of subscribers."

It is clear that the Government then recognised that a case for continued publication of national S&T research journals existed. The level of that subsidy has since failed to keep pace with the effects of 33% inflation over the period that the journals have been published by the Royal Society. In addition, a 44% increase in publishing by New Zealand researchers worldwide, and an ever-growing demand for faster times to publication, means that the New Zealand journals are in danger of being "left behind" by not performing to their full potential because of their diminishing resources. Obviously, the need for continued, and increased, government support is paramount for the New Zealand journals to continue to function for the good of New Zealand and to showcase New Zealand S&T to the world.

Publication and dissemination is the final act of the research process and an integral part of it.

The cost of publication is trivial in comparison to the cost of undertaking the research.