AMSI
AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

Mr Russell Chafer
Committee Secretary
Standing Committee on Industry, Science and Innovation
PO Box 6021
Parliament House
Canberra
ACT 2600

12 February 2010

Dear Mr Chafer,

Please find attached the Australian Mathematical Sciences Institute's submission to the House of Representatives Standing Committee on Industry, Science and Innovation's inquiry into Australia's International Research Collaborations.

I would welcome the opportunity to appear before the Committee with the Chair of our Scientific Advisory Committee, Professor Jon Borwein, and one or two other colleagues.

Yours Sincerely,

Professor Geoff Prince
Director
Australian Mathematical Sciences Institute
111 Barry Street
The University of Melbourne
Victoria 3010 Australia
p: 03 8344 1779
f: 03 9349 4106
e: director@amsi.org.au
w: www.amsi.org.au

Inquiry into Australia's international research engagement

House of Representatives Standing Committee on Industry, Science and Innovation

Submission from the Australian Mathematical Sciences Institute

About the Australian Mathematical Sciences Institute (AMSI)

The Australian Mathematical Sciences Institute (AMSI) is a national collaborative venture of 35 universities and organisations around Australia. Established in 2002 AMSI's mission is to promote and strengthen the understanding and use of the mathematical sciences in Australia's culture, science and economy. There are three main programs: Science; Education; and Business, Industry and Government.

In 2008/09 AMSI enhanced Australian mathematical sciences through the sponsorship of 45 distinguished international lecturers to visit Australia, promoted international collaboration through support of 21 research workshops and initiated collaboration between AMSI, MASCOS and UNESCO with the annual industry workshop on *The Mathematics of Water Supply and Pricing*.

Many activities in AMSI's Science and Business, Industry and Government programs are collaborative with the Australian Research Council (ARC) Centre of Excellence for Mathematics and Statistics of Complex Systems (MASCOS). AMSI's activities are also enhanced through a partnership with the Pacific Rim Mathematical Association (PRIMA) and Mathematics of Information Technology and Complex Systems (MITACS), a Canadian Network of Centres of Excellence (NCE) for the Mathematical Sciences.

Response to the Inquiry Terms of Reference:

1. *The nature and extent of existing international research collaborations*

Almost all active researchers in the mathematical sciences have international collaborators. While we don't have an exact measure, at least one third of collaborative research in the mathematical sciences will have an international component. In some parts of the discipline the figure will be much higher. In general these collaborations involve a face to face component (reciprocal visits, conference/workshop attendance) and a remote component (email, skype, videolink). The extent of the first component varies according to the scale of the project: for centres of excellence is it extensive, for individual ARC funded projects it may mean a few face to face events a year and for

Postal Address: 111 Barry Street
c/- The University of Melbourne
Victoria 3010 Australia

Email: enquiries@amsi.org.au
Phone: +61 3 8344 1777
Fax: +61 3 9349 4106
Web: www.amsi.org.au

otherwise unfunded research it may be only be once every couple of years. The second component mainly supports the logistic aspects of the collaborations.

International research collaborations have led to Australia's participation is international bodies. For example Prof. Cheryl Praeger of the University of Western Australia is a member of the Executive of the International Mathematical Union and Professor Peter Hall of the University of Melbourne is currently president of the Institute of Mathematical Statistics. Professor Ian Sloan of the University of New South Wales was President of the International Congress of Industrial and Applied Mathematics and a key person in the 2003 Congress held in Sydney.

As we indicated in our preamble, the thrust of AMSI's scientific program is the support of international collaboration. Our programs have significantly increased Australia's international engagement in the mathematical sciences. This is of enormous importance to the nation.

2. *The benefits to Australia from engaging in international research collaborations*

Our discipline is truly international in nature and it would wither in Australia without international collaboration. Exposure to the latest developments in mathematics and its many areas of application is best done through active engagement and this means collaboration and support for activity in the international arena. Australian mathematics cannot be sustained by simple observation of developments elsewhere..

The widely recognised strategic role of mathematics in scientific and commercial endeavour along with its global character means that international collaboration is critical in maintaining Australia's capabilities in areas from molecular biology to financial risk analysis. Australia has to engage in international research collaborations if it is to benefit from the vibrant, diverse world that is modern mathematics. We must be able to remain at the leading edge of key areas of innovation and have the breadth to adapt new technologies for national benefit.

The training of early career researchers in the mathematical sciences depends critically on exposure to global developments and for this reason many PhD graduates destined for research careers take up postdoctoral positions in Europe and the US before returning (although many do not). Many career-long international connections are made during these postdoctoral years and it is a significant factor in the international nature of mathematical sciences in Australia.

3. *The key drivers of international research collaboration at the government, institutional and researcher levels*

Government: ARC competitive grant schemes and to a lesser extent NH&MRC grant schemes. The low success rates and low levels of funding for successful applications compromise the utility of these schemes.

Postal Address: 111 Barry Street
c/- The University of Melbourne
Victoria 3010 Australia

Email: enquiries@amsi.org.au
Phone: +61 3 8344 1777
Fax: +61 3 9349 4106
Web: www.amsi.org.au

Institutions: Sabbatical leave programs, various small grant schemes at departmental and faculty levels, departmental research funds. Modest amounts not usually more than $10,000 for competitive grants and not more than $5,000 pa for departmental funds. Many smaller departments do not have such funds.

Researchers: use of personal research incentive funds. Uncommon and irregular and not usually exceeding $5,000 pa.

Discipline level: Institutes akin to AMSI are rare in the spectrum of disciplines in Australia. AMSI spends around $150,000 pa on conferences and workshops and lecture tours by eminent mathematicians. A significant portion of this can be regarded as support for international collaboration.
In addition, the Australian Mathematical Society and the Statistical Society of Australia Inc. support international collaboration through invited plenary lecturers at annual and biannual discipline conferences.

4. *The impediments faced by Australian researchers when initiating and participating in international research collaborations and practical measures for addressing these.*

The two major impediments are lack of funds and lack of e-research infrastructure.

Lack of funds:

(a) There are a number of problems with ARC's Discovery Project scheme which impede international collaborations in the mathematical sciences.

- The success rate is low (on average across all disciplines 22.7% of proposals were funded in 2009 although mathematics proper had the highest success rate of 33.5%)

- The funding rate for successful grants is lowest in the ARC panel of Mathematics, Information and Communication Sciences (in 2010 successful applicants got 54.6% of the requested amount compared to the average of 62.9%). The funding shortfall cannot be met in full by the researcher's home institution. **The full cost of successful research programs should be funded by the ARC.**

- The minimum funding request ($20,000 pa) is too high. In Canada there is a two tiered funding system with a small grant scheme with a relatively high success rate which, in the mathematical sciences, funds individual researchers and allows them to undertake the basic international collaboration that is essential to the discipline (conference attendance and reciprocal visits to colleagues). **The ARC should institute a small grant scheme.**

Postal Address: 111 Barry Street
c/- The University of Melbourne
Victoria 3010 Australia

Email: enquiries@amsi.org.au
Phone: +61 3 8344 1777
Fax: +61 3 9349 4106
Web: www.amsi.org.au

(b) In the majority of OECD countries there are national, discipline wide, government funded research institutes in the mathematical sciences which run international (theme) programs which bring the world's foremost mathematicians to collaborate with local researchers for extended periods.

In Australia, AMSI is the national institute. It does not receive an operating grant from the Commonwealth and its research program is funded from member subscriptions. It does not have the resources to run an internationally competitive research program of the type described. At the moment it is easier for Australian mathematicians to organise an international theme program at the Newton Institute (UK) than here in Australia. **AMSI must have Commonwealth funding for a rolling 4 year research program in order to sustain Australia's international collaborations in the mathematical sciences.**

Lack of e-research infrastructure:

AMSI, with Commonwealth funding of around $1M and matching institutional funds, has equipped a dozen of its member mathematical sciences departments with advanced electronic conference/teaching rooms for distance collaboration. However, current Commonwealth e-research funding guidelines support only central facilities whereas our facilities are in mathematical sciences precincts. In order to take maximum advantage of nationally distributed theme programs the discipline needs to complete its dedicated e-research infrastructure. Because of the relative simplicity of these rooms the capital costs are less than $2M in total. The operating costs are insignificant by institutional standards but significant by departmental standards so provision will need to be made of around $50k per room per year, about $1.25M pa. This infrastructure cost should be seen as part of the total national research institute (AMSI) budget.
e-research capacity within mathematics departments is a key component in improving Australia's international collaborations in mathematics.

5. *Principles and strategies for supporting international research engagement*

Some facts:

The mathematical sciences have one of the highest international impacts of all Australian disciplines (see Thomson ISI summary attached).

In 2009 the mathematical sciences was the most successful of all disciplines in the ARC funding round (see table attached).

The Australian mathematical sciences share of world mathematics output is smaller than the corresponding share of most other Australian disciplines (see Thomson ISI summary attached). (So we are very high performers on a small base.)

The mathematical sciences in Australia critically depend on international collaboration.

Postal Address: 111 Barry Street
c/- The University of Melbourne
Victoria 3010 Australia

Email: enquiries@amsi.org.au
Phone: +61 3 8344 1777
Fax: +61 3 9349 4106
Web: www.amsi.org.au

Our ability to deliver national benefit, support government initiatives such as the square kilometre array and the synchrotron, and to provide for the quantitative developments in the humanities and the social sciences depends on our integration into the global discipline that is mathematics.

The mathematical sciences in Australia are unique on the national stage in having AMSI: a discipline wide, discipline funded and innovative institute with an established track record of delivering national benefit.

As a result:

The Australian government can be guaranteed that increased support for international collaboration in the mathematical sciences will yield outcomes of the highest quality with an impact in many strategic areas.

Strategic measures for the Commonwealth Government:

- **The full cost of successful research programs should be funded by the ARC.**
- **The ARC should institute small grant scheme. This will significantly boost international collaborations.**
- **AMSI must have Commonwealth funding for a rolling 4 year research program in order to sustain Australia's international collaborations in the mathematical sciences. This should include increased e-research capacity within mathematics departments.**

A final comment:
In his 2009 independent assessment of Australian university research, *The State of Research In Australian Universities*, Thomas Barlow writes

"According to a recent comprehensive assessment of Australian university research, investment in mathematical sciences R&D appears to have tracked with growth in the university sector as a whole over the past decade. But investment growth has also become increasingly concentrated, with a diminishing number of institutions active in the field. Four institutions now account over half of all Australian university R&D expenditures in mathematics and statistics and for nearly two thirds of national competitive grant income in the field. At the same time, research in mathematics and statistics is essentially non-existent in around half of all Australian universities.

The tragedy of this situation is that mathematics is a foundation for the advancement of knowledge across all quantitative fields. It is also a discipline of growing direct relevance to broader Australian society. R&D activity in mathematical sciences has quadrupled across Australian businesses over the past decade, rising from $12 million in 1996/97 to $48 million in 2006/07."

Postal Address: 111 Barry Street
c/- The University of Melbourne
Victoria 3010 Australia

Email: enquiries@amsi.org.au
Phone: +61 3 8344 1777
Fax: +61 3 9349 4106
Web: www.amsi.org.au

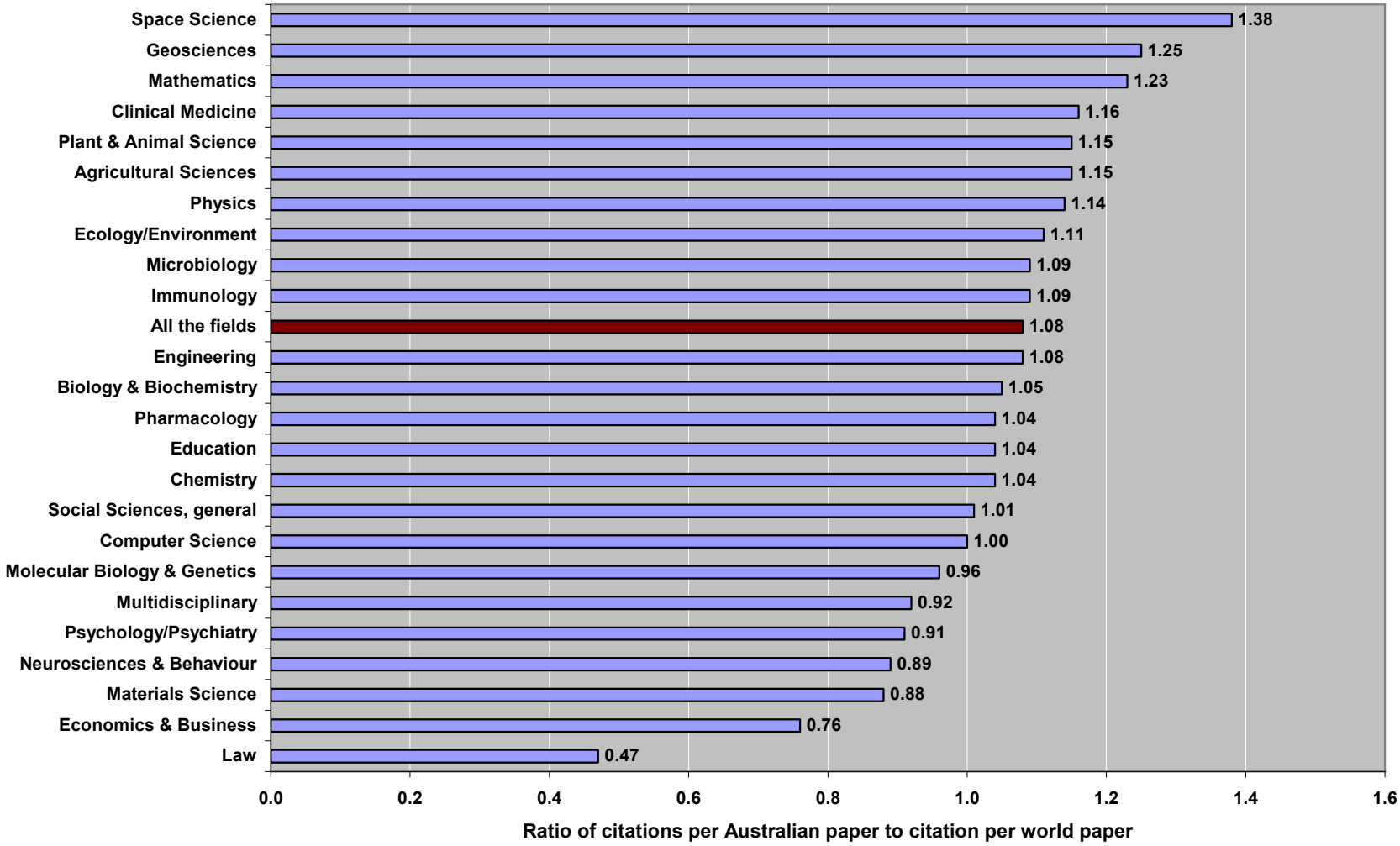
Australian mathematical sciences desperately need Commonwealth attention. Improving research capacity in this fundamental area is intimately tied to international engagement and the measures AMSI recommends will have a major impact on the problems diagnosed in the Barlow report.

I would welcome the opportunity to appear before the Committee with the Chair of our Scientific Advisory Committee, Professor Jon Borwein, and one or two other colleagues.

Yours Sincerely,

Professor Geoff Prince
Director
Australian Mathematical Sciences Institute
111 Barry Street
The University of Melbourne
Victoria 3010 Australia
p: 03 8344 1779
f: 03 9349 4106
e: director@amsi.org.au

5.1.14 Impact of Australian scientific publications relative to world – by field of research, 2001-05



Source: Thomson ISI, National Science Indicators database, 2006.

Projects by Research Fields, Courses and Disciplines (RFCD Code)

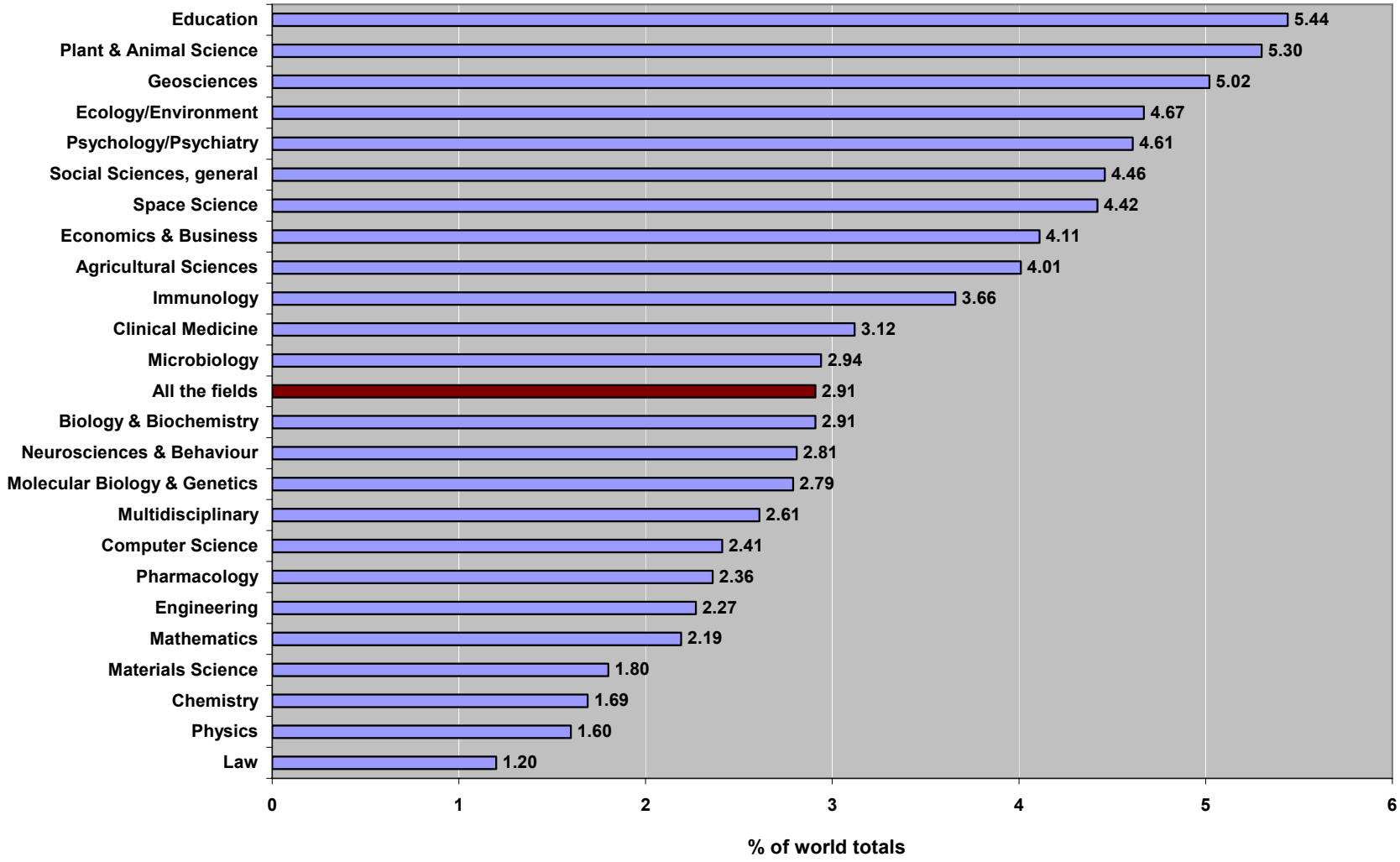
Discovery Projects – Proposals for funding commencing in 2010*

RFCD	Classification	Proposals Considered	Proposals Funded	% Success Rate
30	AGRICULTURAL, VETERINARY AND ENVIRONMENTAL SCIENCES	90	22	24.4%
31	ARCHITECTURE, URBAN ENVIRONMENT AND BUILDING	42	9	21.4%
38	BEHAVIOURAL AND COGNITIVE SCIENCES	194	63	32.5%
27	BIOLOGICAL SCIENCES	563	126	22.4%
25	CHEMICAL SCIENCES	267	57	21.3%
35	COMMERCE, MANAGEMENT, TOURISM AND SERVICES	134	20	14.9%
26	EARTH SCIENCES	180	46	25.6%
34	ECONOMICS	99	31	31.3%
33	EDUCATION	111	19	17.1%
29	ENGINEERING AND TECHNOLOGY	651	142	21.8%
43	HISTORY AND ARCHAEOLOGY	137	39	28.5%
28	INFORMATION, COMPUTING AND COMMUNICATION SCIENCES	336	57	17.0%
40	JOURNALISM, LIBRARIANSHIP AND CURATORIAL STUDIES	26	6	23.1%
42	LANGUAGE AND CULTURE	145	29	20.0%
39	LAW, JUSTICE AND LAW ENFORCEMENT	95	25	26.3%
23	MATHEMATICAL SCIENCES	173	58	33.5%
32	MEDICAL AND HEALTH SCIENCES	169	33	19.5%
44	PHILOSOPHY AND RELIGION	72	18	25.0%
24	PHYSICAL SCIENCES	270	63	23.3%
36	POLICY AND POLITICAL SCIENCE	83	19	22.9%
37	STUDIES IN HUMAN SOCIETY	153	28	18.3%
41	THE ARTS	78	15	19.2%
	Total	**4068**	**925**	**22.7%**

*Withdrawn Proposals are not included

ARC 2009: http://www.arc.gov.au/pdf/grants10/DP10_select_stats.pdf

5.1.13 Australian scientific publications as a percentage of world totals – by field of research, 2001-05



Source: Thomson ISI, National Science Indicators database, 2006.