Submission to Higher Education Review

The Australian Mathematical Society welcomes this opportunity to comment on Higher Education in Australia. The Society has many concerns about the state of the mathematical sciences and these have been documented in the FASTS Occasional Paper *Mathematical Sciences in Australia: Looking for a Future.* The Society believes that it also has a number of concrete suggestions to make that could begin to address its concerns.

The Society is particularly concerned that issues in the mathematical sciences be considered in the context of teaching, research and industry links across the spectrum of activity. The higher education sector is crucial to each of these but, in turn, it is affected by each of them. Similarly education in schools and industrial mathematics is affected by the higher education sector.

The mathematical sciences are critical to young peoples' life chances, to research and innovation, and to industry. They are not just critical to science and engineering but also to areas such defence security systems and financial services. Other nations such as the United States and Singapore recognise this and are investing heavily in the mathematical sciences. This has created a highly competitive global market for mathematical expertise.

Australia has not been protecting its assets in this situation. So far it is the higher education sector which has been most affected but this has the potential to seriously affect other education sectors as well as industry.

The two most crucial aspects of this neglect are:

- The continued loss of highly skilled mathematicians and statisticians to overseas,
- The higher education sector is not producing enough mathematical scientists graduates or postgraduates to meet current or emerging needs.

The data contained in the FASTS occasional paper, and recently updated and attached as an appendix to this submission, indicate a 30% reduction in the number of mathematical scientists in our Universities. A substantial proportion of this reduction is due to the non-replacement of leading researchers emigrating overseas. Further, even when positions are advertised, they seldom attract the quality of applicant represented by those leaving.

Within the higher education sector, this reduction is occurring in other key areas of science including physics and chemistry. To use a sporting analogy, if 30% of the athletes at the Australian Institute of Sport left to compete for other countries there would be a national enquiry. Yet it seems to be acceptable for Australia to lose our leading University researchers.

The impact is being felt in many ways. In putting together possible Centre of Excellence bids for the genome-phenome and complex/intelligent systems priority areas, the shortage of mathematical scientists is being emphasised by multiple requests to the same people to be involved in many different bids. Put simply, there is now a serious shortage of mathematical scientists to collaborate across discipline boundaries in designated priority areas. At a more subtle level,

reductions in the number of courses offered, large tutorials, over-reliance on sessional staff and other aspects impact on the quality of teaching which exacerbates the difficulties in generating more graduates.

A question that is occasionally asked is whether all universities need a mathematical sciences department. While the study of engineering, physics, chemistry and geophysics are recognised as requiring a high level of mathematical training, disciplines such as computer-science, economics, finance, psychology, biotechnology also require considerable tertiary mathematics if graduates are to be able to adapt to the global developments. Increasingly the biological and medical sciences are requiring higher level statistical skills.

The question thus becomes: how to employ mathematical scientists to efficiently and effectively deliver these skills to undergraduates. Experience, both in Australia and abroad, has shown that fragmenting mathematical and statistical teaching by embedding it across a range of application disciplines is more costly, produces poor educational outcomes and mitigates against the employment of high quality staff. A separate issue is whether mathematical scientists in all universities should be employed to undertake research as well as teach. However, mathematical scientists are not tied to research laboratories and it should be possible to give them the option of scholarship or research wherever they are located. This is essential if quality staff, who are in touch with contemporary mathematics, are to be attracted to university teaching.

The data in the appendix indicates that Australia is fundamentally out of step with international trends. For example, not only is the United States keeping its own graduates, but some 30% of mathematical scientists employed as academics or in industry are overseas born. These include many Australians.

Currently there is no DEST policy on research in higher education institutions, no source of advice on the level to which it should be supported from the block grant, and no knowledge of the extent to which the research output of Australia's universities has diminished in the last five years. The reliance on the ABS figure which imputes 30% of the salaries of academic staff as a contribution to national research spending is out of date.

When the Unified National System was created the role of research, innovation and technological change in driving economic growth was not widely accepted in Australia. The UNS relative funding model meant research money was now more thinly spread. At the same time many more academics were introduced to the system who did little or no research, contributing to the inaccuracy of the 30% of academics time being spend on research.

The `efficiencies' extracted from the various enterprise bargaining rounds have been at the expense of research and teaching. The effect of the rise in average staff student ratios from 14:1 in 1993 to near 20:1 in 2002 (reported in the Australian 5/6/2002) is to make many academics full-time teachers. This erosion of working conditions is reported as a primary concern by researchers leaving the country. It is likely that the `efficiency' to be extracted from the next enterprise bargaining round is the elimination of research as an expectation of many academics. This outcome would be so at odds with the international norm as to make Australia even more

uncompetitive in the employment market than the data in the appendix indicates we already are. It will then no longer be possible for the tertiary sector to contribute to innovation.

The lack of a policy for maintaining strength in areas of national importance in higher education is out of line with the thrust of *Backing Australia's Ability.* It must be addressed as part of the priority-setting exercise now underway in conjunction with this review in higher education.

The creation of complex/intelligent systems, photonics and nanotechnology as priority research areas will not lead to a rapid increase in Australian contributions to them unless they are supported by a strong mathematics and physical sciences presence in the higher education sector. The rundown in high-quality staff in our universities, and the lack of resources to build new laboratories, are a major impediment.

In view of these matters the Australian Mathematical Society recommends consideration be given to several issues:

* Addressing the problems that are causing the emigration of our leading mathematical scientists.

* Ascertaining the real level of research activity by academic staff in our higher education institutions with the objective of determining the real contribution to Australian research of the UNS.

* The need for a whole of government approach to research and teaching expenditure, including that expenditure contained in the higher education block grant.

* Encouraging more collaboration within discipline groups and countering the opposing effects that university administrators currently have on this.

The AustMS also recommends:

* That the IGS, RTS and other formulae are rethought in a coherent policy framework that supports excellence in teaching and research. This should include an analysis, by the ABS or another appropriate body, of the real level of research activity by academic staff.

* That initiatives such as the Australian Mathematical Sciences Institute be supported at the Federal and State level as a model of a collaborative approach by a discipline area to improving research, industry links, post-graduate education and teacher professional development.

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