

NATIONAL SCIENCE ACADEMIES AS ONE DRIVER IN KNOWLEDGE-BASED DEVELOPMENT

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Introduction

This forum addresses the important question, 'How should modern science academies be structured to best drive knowledge-based development?' That this very question is asked is significant because it starts with the premise that this is what an academy should do: that it should be a driver in knowledge-based development and not merely a collection of distinguished scientists basking in the glories of past science with little thought to how this science could and should be used to improve the human condition.

The Australian Academy of Science (AAS; www.science.org.au) agrees with the proactive rather than passive role and its formation was driven by a national need to improve science and technology at a critical time in the development of the Australian society. The AAS's objectives then and now are to promote science in Australia at all levels and this includes how best to align science and technology with national aspirations.

This is stated in our Charter: 'To promote, declare and disseminate scientific knowledge, to maintain standards of scientific endeavour and achievements in the natural sciences in Australia; and to recognise outstanding contributions to the advancement of science.'

We address this through four major programs:

- recognition of excellence in scientific research;
- development of science education and public awareness programs;
- development of science policy directed at national needs; and
- linking Australian science into global science through the fostering of international programs.

These programs will no doubt echo those of most active academies of science, with variations in emphasis depending on national needs. Thus I do not think that I can or should tell you what is good for your academy. Instead, I will describe what, why and how we do it, and then leave it to you to decide whether this is indeed an appropriate model for you. In return, I will be looking

forward to your ideas on how we may improve upon our ability to contribute to knowledge-based development.

A brief history

The AAS is an independent body of Australia's leading research scientists, created very much in the image of the Royal Society of London. It does not have its own research institutes – these occur within CSIRO and the research arm of our universities – nor does it have any statutory obligations to government.

The AAS was established in 1954 at a time of the burgeoning of science globally and nationally, and a time of post World War II recovery and reconstruction but with a void in the area of science policy development. This made it an appropriate time to form an independent national academy and this proceeded with the full support of the Federal Government, in recognition that such a body was the best way to advance science and technology in Australia. Thus from the beginning an important objective of the AAS was the promotion of scientific endeavor in Australia, including through the development of international links.

Also because of the then existing void, the AAS has been concerned from the beginning with science policy issues in Australia. The emphasis on this has changed as institutional arrangements for decision-making about science have evolved and other bodies were created to meet new needs. Thus the AAS initiated the early discussions on why government should establish a national advisory council for scientific policy advice. This finally came about in 1977 with the establishment of the Australian Science and Technology Council (ASTEC) as a statutory body with a strong representation, including its chair and deputy chair, from the AAS. The role of the AAS in creating this was specifically acknowledged by the prime minister of the day that, '...over many years...the Academy...led the fight to have a sensible and properly based science advisory council established in Australia.' I mention this because, then and now, when Academies seek to influence governments they have to be prepared to work on time scales that are longer than the usual political time scales and to work with different governments. This determines the balance between providing objective advice and being a lobbying body.

ASTEC was later changed to the Prime Minister's Science and Technology Council with the Presidents of AAS and of the more recently created Australian Academy of Technological Sciences and Engineering (ATSE) as ex officio members. This subsequently became the Prime Minister's Science, Engineering and Innovation Council. The latter forms of the councils, free of executive responsibilities, have had a distinct advantage of bringing science and technology issues directly to the attention of the prime minister and to government ministers by working

through standing committees that prepare the material for the ministerial presentations. They have resulted in a greater high-level awareness of how science underpins much of what modern governments do and they have been able to raise emerging issues earlier than may otherwise have occurred. But being political creations, their continued existence can never be taken for granted and at present the government is considering restructuring it to a 'Prime Minister's Innovation Council'. This has an inherent risk of the debate becoming increasingly dominated, not entirely inappropriately, by economic issues in which the need to build the strong and long term underpinning science and technology foundation may recede into the background. The challenge for our academy is to ensure that this is not allowed to happen.

With the creation of government advisory bodies, with increasing numbers of scientists within government bureaucracies, and with the formation of other professional bodies – often formed with strong support from the AAS – the void I mentioned earlier has largely been filled. Thus the earlier role of the AAS to contribute to the development of science policy has been increasingly replaced by the need to be able to respond quickly to the many matters of scientific concern raised by government. The AAS has responded to this by creating a committee for science policy with the express purpose of anticipating and responding to policy issues emanating from government. The secretariat works through the Council of AAS, using the membership as a whole as well as outside advice, to identify emerging issues, to prepare position papers on significant issues, to respond to the calls for inputs into government inquiries, and to respond to the public statements made by government on matters within the AAS's competence.

Some special challenges

As I have mentioned already, the AAS is independent of government although we do receive a small grant-in-aid for partial support for our administrative staff and for infrastructure costs. The rest of our operating and capital costs have to come from contracts and private sources. This has advantages and drawbacks. Independence means that we can offer free and fearless advice to government. But this has to be balanced with reality. Free advice that is constantly ignored by government is not of great value. Nor is advice that simply rubberstamps government's wishes terribly useful.

The path between the extremes can be precarious but it is best assured if the advice is seen to be:

- high quality, considered and reliable;
- timely, both in responding to government requests and in anticipating future issues;
- independent of institutional biases; and
- independent of the government of the day and consistent when governments change.

Underpinning these requirements is the need to maintain, recognise and reward excellence in science. Members of the AAS should be the elite of the country's practicing scientists who have been elected for their own contributions to science. This can mean that election may come rather late in a scientist's career and in disciplines that are already mature. Unless addressed in a pro-active way this can of course lead to a 'dormant' institution and the challenge that all academies are faced with is how do you make an elite body also representative of the scientific community? Our approach is not to fix the total membership but to place a limit on the numbers that can be elected in any one year. This is coupled with a pro-active effort to identify potential candidates from across the entire science community who have already made their mark and who show great promise of doing even more, all without reducing the criterion of excellence. There are obvious risks, but I believe that the risk of ossification is greater.

How to provide advice to government across the entire spectrum of science and technologies, on political time scales that are not always consistent with careful consideration, is one of the challenges faced. Australia spreads far and wide with its population unevenly distributed. The membership of the AAS is limited to only a very small fraction of Australia's active scientists, certainly less than 0.3 per cent, and there is always the risk of the body not being representative of Australian science, particularly at times of rapid evolution in newly emerging areas.

Plus we have a federal system of government in which many issues of education, infrastructure development and public health come under state government jurisdiction. This creates special problems for the AAS: how to get representative regional representation of its membership without affecting the very quality of the membership, and how to develop science and technology inputs into state government policies? How can we be representative across the country and across disciplines and maintain an active membership that is prepared to contribute to the AAS goals, and yet retain the highest standards for election?

That is our constant challenge and we keep our election process under constant examination. I do not believe that there is a linear relationship between the size of an 'effective' academy and the population of a country and I suspect that a better mathematical model is more like a parabolic function in which countries with a small population base need a proportionally larger percentage of its scientists as members than countries with large populations. And if one looks at academies that are seen to be effective in promoting science and technology in their countries one can in effect see such a relationship that we were able to exploit a few years ago to convince our members to increase the number of yearly elections from 12 to 16.

But there may be other ways in which academies can be more effective in providing timely and quality advice. One is to make use of a country's diaspora where this exists, as Taiwan obviously does well. In our case, this could be done through greatly expanding election in the corresponding members category or by removing the requirement that members have to be residents in Australia at the time of election. This is something that we do not yet do well and we do not draw on the talents of leading Australian scientists based in overseas universities and research laboratories as much as we could and, I believe, should.

Another way is to engage with the broader scientific community in the country and this we do better making use of our discipline-based national committees that are made up of AAS and non-AAS members. These committees serve as a link with other Australian scientists, including scientific professional bodies, as well as acting as gateways to international linkages. Their activities include discipline reviews and the development of discipline decadal plans, alerting the AAS to particular issues brewing in the background, organising workshops and conferences, and contributing to policy development. The benefit of these committees is that we can access a younger and a more 'at-the-coalface' part of the community for our advice.

A third way is to for the AAS to engage with young scientists and we attempt this in a variety of ways; through mentoring and early-career programs, through our High Flyers Think Tanks and Australian Frontiers in Science programs and through the preferential treatment of young scientists in our international exchange programs.

A fourth way is for linking with the other learned academies in Australia. This includes particularly ATSE on matters of science and technology and we do this in several ways, depending on what is considered to be the most effective response to a particular situation. It may include joint responses to government initiatives or it may include joint workshops and symposia on, for example, climate, water, energy, resources. On issues with a broader social implication we will also join forces with the Academy for Social Sciences in Australia and the Australian Academy for the Humanities under the National Academies Forum umbrella. These have included reports on sustainability and on the public view of nuclear power, as well as on historical issues where science has played a role in early Australian discovery and adventure.

The present condition

An early (1957) issue on which the AAS provided (unsolicited) advice to government was on scientific and technological manpower supply and demand. The issues then raised dealt with science and mathematics education, with factors that determine future career decisions by young students and early-career researchers, and with the setting of national priorities of science and technology in relation to the needs of the community.

Recently the Australian Government has released for public debate its 'green paper' on the National Innovation System. Reading this alongside the earlier reports may lead one to suspect that little has changed and that the advice 50 years ago went unheeded. But that these very issues are still with us today is more a reflection of their constancy and a reminder that an academy's work is never done.

In saying this, I have to be realistic about what can be done in today's environment. Not being a funding agency, the AAS has to be content with providing advice as one body amongst others. We have to accept that there is little recall when that advice is not recognised, let alone not acted upon. With the growth of science and technology expertise within the government structure the role and significance of an academy's advice is placed under constant review and we have to strike a balance between the advisory role and a lobbying role that many of our members would prefer us to take.

But there is a very legitimate and important role that an independent academy can play. That is to take on the responsibility of pursuing the excellence in the science and technology that underpins the national effort to be an innovative country. It is the wise and long-term investment in innovative human and material resources that provides the springboards for long-term growth in wealth, health, sustainable employment and environmental benefits.

Much of our current activities, over and above the normal AAS responsibility of maintaining and advocating excellence in science, involve this underpinning. Thus core activities involve:

- education at all levels;
- raising the level of scientific understanding of the community at large;
- improving career developments and opportunities for our young researchers;
- retaining a highly skilled basic research capability;
- improving our participation in international programs and enhancing bilateral and multilateral links; and
- contributing to the setting of national research agendas and priorities.

I will touch here on only one of these programs, that of school education not only because it may well be one of the more important things that the AAS has done but because it may show the ways in which we can become more effective in our other operations.

As in nearly all countries, education in general and science education in particular is a matter of great concern in Australia. How does an education system keep up with the changing social make up of the country and with the changes in science and technology itself? Our concern is

particularly critical at the primary school level because this is where bad habits often start: children, innately enthusiastic and curious, not being encouraged to develop a questioning mind; not encouraged to develop a desire to understand and explain the world around them. We have clearly developed the position that because the future will depend increasingly on science and technology to resolve societal issues and because education underpins the wise use of and creative development of tomorrow's technology, we need a national education system that meets the requirements of the future.

This is not the place to explore the reasons why our present system is not meeting our expectations but they are such that they compelled the AAS to develop its own primary school teaching program working within the existing school systems. The resulting program Primary Connections started with a pilot program in 2004 that was independently funded, trialled in a number of schools, and independently assessed. The initial success led to government support for a phase 1 trial across all states and school systems, such that today the program has reached ~40 per cent of schools. Further assessment of the program then led the government this year to fund a phase 2 rollout of the program to reach all primary schools by 2010. Again, this is not the place to go into details of the actual program, except to note some of the reasons for the success. These include:

- AAS backing of the program with the guarantee of quality of the contents of the program and of its independence that has made it acceptable to the different school systems across the country;
- AAS backing was also important to ensure continuity of the program, with minimal disruption if not with minimal work, through the recent change in our federal government;
- that the AAS is seen to be concerned enough to do something about teaching provides an unmeasurable incentive to teachers;
- working with the teachers in designing the program, in providing assistance to the teachers through professional training facilitators to train the teachers who teach the children, in designing a program that links science with literacy and numeracy, and in creating networks for on-going development of teachers who use the program;
- providing source materials for teachers that are simple to prepare and simple to use;
- basing the program on the 5Es approach - engage, explore, explain, elaborate and evaluate – that encourages students to actively develop explanations for scientific phenomena; and
- continuous feedback and evaluation of the components of the program and of the training methods.

Whether the AAS will continue to drive the program on a day-to-day basis beyond 2010 remains to be determined – it is not our mainstream activity and we should be able to move on to our next challenge. But with the importance that we attach to education and with the realisation that its development will never be static, I am certain that we will follow closely what happens in the future. Our next challenge in education lies in the secondary schools. How do we ensure that any progress and enthusiasm made in the primary sector is not dissipated when the students move to the next phase of their education? To this end we have embarked with government support on developing a pilot secondary school program. But here there remains much to be done.

Let me conclude with one reason why I have selected the example of education. It is not just that we are proud of what a supposedly elitist academy can achieve in school education. But it is because it suggests a successful way in which an academy can engage in important national issues. The 5Es approach may actually have much wider application to what we do. Engage with the community beyond the immediate membership so that there is broader ownership of what is put forward. Explore the full range of options available when providing advice so that it is clear that it is comprehensive and not self-interest. Explain the advice to the community as a whole and to policy makers in particular at the levels appropriate. Elaborate the importance of science and technology for the welfare of society at all levels. Evaluate and recognise the excellence of scientific work where and when this occurs.

Information on the full range of the AAS's programs can be found at: www.science.org.au