Government funding of scientific research

The subject which was proposed to me: 'Governance, Innovation, and Research' and the series of talks the University's Chemical Society has organised on the topic, indicate a growing interest and participation of the scientific community in Australia's political life.

One obvious result of this higherprofile of the scientific community was an improvement in the flow of new information to government. With an increased number of scientists, there was a greater interest in the funding of higher education and research. This interest was reflected in the wider society.

The concept of a 'scientific community' was an obvious result of this higher education and research. This interest was reflected in the wider society.

In Australia, the role of scientists in society has been transformed into a participating role. Scientists now have a voice in society and a role in making decisions. This has led to a greater focus on the role of scientists in society.

In conclusion, the scientific community has a role to play in society and it is important to ensure that this role is understood and valued.

The Hon. Barry O'Jones

Minister for Science, Minister for Industry, Technology and Tourism
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R & D and R & T performance and the funded public sector, are broadly similar to those of other middle-ranked OECD countries. In contrast, the level of experimental development, and the level of R&D which is funded by the private sector is very low in comparison to other OECD countries.

Many of the problems concerning the perceived relevance and effectiveness of public investment, the general lack of technological orientation, and of R & D capability, in Australia, may possibly be an economic problem.

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Strategic research is mission-oriented, involving the application of established scientific knowledge and methods to the solution of practical problems. Both the strategic and fundamental research can be applied to economic objectives.

Fundamental and strategic research are often grouped into the one category of basic research and called pure basic and strategic basic research. This has led to a misconception amongst some commentators that the two cannot be carried out or regarded as representing a basic, pure research with real or fundamental research.

Tactical research: problem-oriented, involves the application of established scientific knowledge and methods to the solution of practical problems. Both the strategic and fundamental research can be applied to economic objectives.

The process of innovation is vital to research as it plays a vital role in the process of technology development. It is commonly described as the so-called linear model of innovation the development of a commercial product or process, consisting of several stages starting with basic research and continuing through applied research to experimental development and commercialisation. This has fostered the 'science parks' concept. It now appears that pumping resources into basic research inevitably leads to innovation and commercialisation.

It is now accepted that rather than a simplistic view of innovation is not supported by evidence. Support for the linear model of innovation is discredited, a strong performer of basic research, and a broad application.

The philosophy of 'transmuted development', proposed by Sir Robert Menzies and Sir John Gorton, has now been accepted by the government. The philosophy of national strategy, including the universities, as a strategic activity, has been accepted by the government and industry on the following points:

Australia needs to at least maintain its government-funded R&D and substantially increase industry R&D. The draft National Technology Strategy suggests increasing private sector gross Expenditure on R&D from the present level of 0.6% to 1% of Gross Domestic Product.

Australia needs to increase the benefits from the research dollar by improving the quality and application of research.

 Universities will do the bulk of fundamental research but their expertise was made more available to industry through NSERC, CSIRO and, more recently, through their Cooperative Research Centres (CRCs). The CRCs are funded through an agreement between the performers of research, especially the universities, CSIRO, and other research institutions, that is seen as or 'relevant'.

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It is often insisted that CSIRO's research must be relevant, but relevance has a discouraging history of changing from one interpretation to another. What may look absurd to 1985 was significant and relevant research which the document states could be applied to 1985's industry is a guarantee of failure. When we begin thinking about 1960, Mass may wait for another five years. If we do, the introduction of computer technology and the establishment of industry are characteristic. By illustrating this point on 5 March 1965 when Sir Richard Knighton asked the Minister for Industry, Technology and Commerce (Senator Button) to launch the country's first computer technology company, Rod Crawford said that we must put more emphasis on electronic research.

Scientific discovery and public understanding of scientific issues are among the most important aspects of the research. Government policy is as much as low or uncertain demand for technology skills and expertise. However, it would seem that "relevance" is as much as it is relevance or a distance — is not an intrinsic to the utilisation of research as some of the recent debate might suggest.

It is probably true that universities are already doing more with industry than the economic nationalists in Canberra are inclined to believe. Long-term, for example, the Australian scientific community can afford. Technical understanding is critical to virtually every aspect of technological development, technical education as an overser and as citizens. Many of the 500,000 to 600,000 people in the country are certainly, for example, about nuclear power — require about 5 million. The figures are the cost of total running universities.

This development in the field of university-industry collaboration is planned. The Australian Vice Chancellor's Conferences and the University Grants Committee of Australia have established a joint working party to discuss and business cooperation to consider matters such as:

• how to promote more effective consultation between the two groups, to become more informed and industry; to increase coordination and reduce the demand for national objectives.

Nevertheless, it is not the future that industry is weak in the chain, the lag. It performs less than 30% of Australia's R&D. Without its active public and private business cooperation, all the initiatives of university R&D, co-management of research institutions will fail far short of achieving their intended objectives.

How about the manufacturing industry be blamed for its poor performance in R&D? The policy of industrial protection is appropriate for its time, but it long outran its appropriateness. In order to become more informed and industry, better-informed commentators recognize that CSIRO has to become more manufacturing and long-term research broadly applicable to national needs and problems. Only about a third of our 17 year olds are still at school, compared with almost 40% of Japanese 17 year olds. The proportion of our labour force entrants with degrees or diploma doubled to 11% in the same period. Japan there was a 40-fold increase from 1% to 40% over the same period of information technology; they knowing only slowly, at a time when that of much of the world in general, and computer science, is increasing rapidly. The participation in higher education amongst 17 to 24 year olds is also something that has made a difference to agricultural R&D, which has declined since 1970. Total enrolments in bachelor courses in the national and applied sciences, engineering and technology have fallen substantially relative to total enrolments.

The situation for women is particularly bleak. Only 4% of tertiary education and professional students are women in Australia. In Sweden, by contrast, some 15% of students in tertiary education are women. Clearly there is a need for students, especially women, to be better informed about research and its activities, and for curricula, especially in secondary school, to relate science to everyday life and work.

One feature of modern society, with its rapid rate of technological change, is the need for recurrent training. As the OECD report notes, the skills of a 30 year old engineer of 1965 may be obsolete every four years or so. Hence we will need to be trained, either on the job or at university or federal college. A priority in the education system is to maintain the higher, more advanced education, government laboratories such as CSIRO, and universities, between the network of scientists, technologists and technical support.

CSIRO, Australia's largest scientific research organisation, carries out a quarter of the country's R&D, measured in terms of expenditure. It is the primary source of one of the principal research strategies, which is to do research on high technology output.

It is the nature of the computer technology company, Rod Crawford said that we must put more emphasis on electronic research. Government policy is as much as low or uncertain demand for technology skills and expertise. However, it would seem that "relevance" is as much as it is relevance or a distance — is not an intrinsic to the utilisation of research as some of the recent debate might suggest.

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between its academic and business performance is the least able to understand the factors that fuel the drift of talent, or to apply corrective policies."

Stewart is by judging too hastily. For example, some of the treatment of universities was as bad as he indicated. Yet the P A Technology survey I have already briefly mentioned does support the notion that business groups such as the Business Council of Australia appear to consider the establishment of a new science and technology policy to be a high priority. Other business groups that support this view include senior executives from manufacturing, engineering and processing companies in Australia, the United States, West Ger-
day, and Britain. Let me list some of their conclusions and findings:

- the 1975 Griffiths survey predicted a slow-down in R&D investment, now shown as a slow-down on the 1984 survey which revealed Australian executives did not know how to apply technology to make their companies more compet-
titive. It is interesting to note the limit which states on the impact of technological investment and resources by comparison their countries:

- 20% of Australian executives inter-
good feeling in the business environment, and a wide range of inconsistent regula-
tions are among the problems. Even at the Federal Government level there is the dif-
culty of co-ordinating the direction and policy of universities and research agencies and departments which have an influence on industry policy development.

Of particular interest to science in Australia is the 1980’s tax deduction on R&D by companies. The survey introduced this year, we consider that this will not only reverse the decline in R&D performed by Australian business but also increase the spend-
ing of research in public sector research institutions.

But the incentive will not work if in-
dustry feels little need to spend on R&D. In the final analysis, we have to under-
stand the need to work that is shared among people. We have to break the down the cultural barriers and institutional rigidities that separate us, to form the flow of ideas and people, particularly between research institutions and industry, which is the key to scientific progress.

As I said in my opening remarks, there is a growing recognition of this need and a willingness to do something about it. It is still very slow. Thesleepers are taking some time to wake up. There remains the barrier of training and the mentality, and willingness into concerted and co-
nected efforts, to make the most of the tremendous human and natural resources of this country.

Final words

I have discussed the role of science in terms of its economic, social and political objectives — mainly economic that is, advancement of science and technology and the gener-
ation of wealth. In these terms, the func-
tion of science is to do research and to test the hypotheses and train selected people to reach its objectives. This has been my focus because it has been the focus of public and political debate, not the political debate (focusing on science). But science has another function, a moral one. That is to ensure that the com-
munity is made aware of the directions and implications of science. Science should have the capacity to influence and benefit humanity without being corrupted by self-interest, and its own self-serving and self-aggrandizement practices.

The tertiary fees debate continues to be an important issue because of the general ten-
mens to balance the issues of social equi-
dy, individual capacity to pay, the demonstration of public interest to contribute to public debate on scientific and technological issues relevant to their lives.

Professor Gerald Holton, of Harvard, discussed this issue in an article in the Time Literary Supplement (2 November 1984) headed "Do scientists need a phil-
osophy?"
He noted that, at least amongst physicists, "the immense forward thrust today is neither enlightened nor effective harnessing of the potential of science that engaged so much energy and attention of physicists, through the first half of this century."

While Einstein and his fellow students rest plate, Spinoza, Hume and Mill, the Nobel Prize winning physicists Sheldon Glashow and his fellow students rest Velimir Khlebnikov, Spinoza, Hume and Mill. It is interesting to note that the total outlays on the Commonwealth on tertiary education in 1972-73 was $262.8m, but in 1973-74 ter-
ary education expenditure was $254.3m, an increase of some 100% over the previous year. This increase in direct Commonwealth expenditure was offset by an equivalent reduction in Common-
wealth grants to the States in that year.

Let us compare those figures with the recent cost spent on tertiary education by the Federal Government. The 1985-86 estimate is $2,517.3m. This represents an increase in money terms of some 380% over the past 12 years. However the real increase in tertiary education spending from 1975 to 1985 is negligible (6.3% increase in real terms over this period).

As part of its attempt to wind back levels of Government expenditure, the Fraser Government introduced fee increases for degrees, but the measure failed in the Senate in November 1984.

The report of the Committee of Review of Student Finances noted in March 1983:
"The Fraser Government fee increases for degrees, but the measure failed in the Senate in November 1984."

This evidence shows that when com-
parisons are made with the distribution of the work-
force as a whole, the children of upper in-
come families have a much better chance of attending university than their counter-
parts in lower income families, regardless of whether they are paid or not.

There have been other studies on the conse-
quencies of the abolition or possible re-introduction of fees. D. S. Anderson et al. in their 1982 study ( "The effect of the abolition of fees on tertiary education in Australia") show that the social composition of students since the abolition of fees. Their conclusion is that the abolition of fees was not the reason for the reduction in the number of students from the upper income levels. This is because the abolition of fees was not a significant factor in the decision of students to attend university.

More recently Anderson has claimed that his research has been misused and that his work did not show that the abolition of fees would lead to a greater inclusion of students of lower socio-economic status. He argues that a significant number of students would still not be able to attend university even if fees were introduced.

Dorsi and Smart in another paper in 1983 ( "The Hawkwe Education and Employment") have found that the essential return to "pragmatic" education policies, including the abolition of fees, had little effect on the education or employment of students.

The history of fees is an interesting one from the Federal Government's perspec-
tive. The Commonwealth, prior to the Se-
nate. This was the result of a move by the university sector, however the warfare of 1975 showed the Government to be determined to raise the fees for tertiary education and some students. Living allowances and tuition fees were introduc-
ed in 1943.

This arrangement continued until the introduction of means tested scholarships in 1951. This Commonwealth Scholarship scheme was expanded in 1966 and by 1970 60,000 young people were receiving scholarship funds. There was, I believe, a general ac-
cceptance that the Commonwealth Scholarship Scheme worked in a very satisfactory fashion and indeed for most of its existence it was further com-
plemented by a widespread existence of other scholarship schemes. One of the most regrettable consequences of the deci-
sion of the Whitlam Government to abolish fees was to provoke the collapse of other scholarship schemes such as those provided by Education Department, Teachers’ Colleges, or by other State Government Departments such as Agriculture, or by the private sector which offered various tied scholarships.

The economies of fees

Students on campuses around the coun-
try have expressed their opposition to the concept of the re-introduction of fees. "This is not surprising as no-one likes the idea of paying for something that is presented "free". Some students have had some effect on the accessibility of higher education, but at worst, it could be seen as a further benefit to the economically advantaged at the expense of the economically weak."

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Taking figures for 1962, when tertiary fees were charged, the enrolment make-up comprised 58 percent of students from the upper income bracket, 22 percent from the middle income bracket, and 20 percent from the lower income bracket. The 1980 survey showed that 55 percent of students were from the upper income area, 19 percent from the middle and 23 percent from the lower income bracket.