Biotechnology in Australia *by the Biotechnology Consultative Group* (AGPS, Canberra, 1988) pp. xiii + 54, ISBN 0-644-08068-X

In May 1988, at the annual conference of the Australian Biochemistry Society in Adelaide, rumours abounded that the flagship of the Australian biotechnology industry, the company Biotechnology Australia, was to be sold. This company had been set up by CRA back in 1982 and funded lavishly at about $10 million per year since then. So far a buyer has not been found, but the company executives are out searching for one. A few months later, in August 1988, another major biotechnology firm, Australian Monoclonal Developments, was sold. The share prices for many of the other firms are at rock bottom, partly because of the sharemarket crash in October 1987. Clearly, in 1988, all is not well with the biotechnology industry in Australia.

But the most recent official report on this industry sector, completed in June 1988 by the Biotechnology Consultative Group, has not taken note of this fact at all. It speaks blithely of Australian firms "taking a lead role in the development of bio-businesses" and of the government having to foster this through improvements in the investment climate and in the regulatory environment.

How is it that the report completely missed the crucial issue of the current malaise in the industry? Three reasons can be advanced: first, the membership of the committee which produced the report; second, the assumption that science policy is all about inputs; and third, a lack of analysis in the report regarding the industry's output.

The eight members of the Biotechnology Consultative Group are all 'heavies' of the Australian biotechnology scene: five company executives, the President of their Association, the Chairman for the sector on the Industry R&D Board, and the Chief of the relevant Division of the CSIRO. There was not a single outsider amongst them. Interestingly, in these times of tripartite and broadly constituted committees, the members of the Biotechnology Consultative Group were not even self-conscious about how lopsided their group was: they recommended that a Biotechnology Industry Development Board should be set up immediately to co-ordinate future activities in the industry and that they (the Group) should constitute this Board for the time being.

However, for purposes of estimating the financial input for biotechnology development in Australia, the report is quite useful, particularly the Appendix provided by two officers of the Department of Industry, Technology and Commerce. It turns out that as far as support and investment go, Australian biotechnology does remarkably well. Direct Commonwealth expenditure runs at around $100 million per year, comprising about $30 million to the CSIRO; $20 million from the three main funding schemes (GIRD, ARGS and NH&MRC); and $50 million to the universities and non-CSIRO research institutes. All this amounts to about ten per cent of the total annual Commonwealth expenditure on R&D.

It is further estimated that the biotechnology companies are currently spending about $50 million per year on R&D, and the state governments $10 million. A good deal of the private sector expenditure can be recouped from the Commonwealth through the 150 per cent tax deducation. Unfortunately, the estimates provided are not disaggregated sufficiently to allow one to draw the customary pie-charts showing how much each sector pays and how much it performs. In fact, in Australian biotechnology this cannot be disentangled so

easily since there is considerable overlap between the sectors. This is actually a very promising sign, indicating a higher degree of collaboration between the sectors than is generally the case in Australian R&D. It is likely that close to half the funds spent in industry derive ultimately from the government, and that a good proportion of private money — largely that raised on the stockmarket — is spent in the public sector. It would be most useful to know whether in biotechnology we finally have a situation where more R&D is performed on industry projects than in the government and higher education sectors combined.

Unfortunately, the relatively rosy picture that emerges in regard to Australian biotechnology when we look at inputs — say $150 million per year — is not reflected in outputs. Furthermore, the biotechnology report under review is quite deficient in not addressing the issue of outputs at all. To start with, what could we reasonably expect with this level of annual expenditure?

Let us assume that $100,000 per year buys a well-trained researcher, his/her oncosts, some share of buildings, equipment and laboratory consumables, and even some research assistance. At that rate, there might be some 1 500 full-time biotechnology researchers in Australia. If they were all publishing research articles, we might expect some 4 000 solid papers per year. A bibliometric check might bear this out, but I am somewhat doubtful. If bibliometrics ever gets going in Australia, the output of biotechnology might be a good place to start.

Of course, the biotechnology researchers are not just employed in order to write papers. A much more appropriate measure of their output would be the number of patents obtained. But because of the rapid growth of biotechnology, there is a world-wide lag in the processing of these patents. As a result, patent applications have been considered an acceptable measure of output in this sector. In their study of the biotechnology industry in the United States, David Blumenthal and his colleagues at the Kennedy School of Government at Harvard University, have provided some detailed information in regard to patent applications.[1] The following table is abstratced from their paper:

Productivity of biotechnology research investments in the United States

	Patent applications per $US10 m invested	
	in-house research	**sponsored university research**
Large corporations	13.1	22.6
Small firms	20.5	100.3
Weighted industry average	18.2	76.1

Source: David Blumenthal *et al.*, 'Industrial support of university research in biotechnology', *Science,* 231, January 1986, p. 244. Data collected in March-May 1984.

Clearly the university groups working in association with small, innovative biotechnology firms were the most productive at 100 patent applications per $10 million invested. But even the least productive research groups, namely the in-house laboratories of large corporations, achieved 13 patent applications for that amount. Taking into account inflation and exchange rates, one could conservatively estimate that on the basis of the American data, the $150 million spent on biotechnology in Australia could result in over 200 patent applications

per year. Unfortunately, we have no information on how many patent applications are being lodged by Australian biotechnology researchers every year. It would clearly be a most useful measure for assessing how competitive our researchers are on the international scene.

This brings me to my most serious criticism of the report produced by the Biotechnology Consultative Group. It was not considered worthwhile even to question what output has been achieved from the considerable investment in biotechnology in Australia. Research papers and patent applications are fairly basic output indicators. It would be better still to know about the sale and export of products. But whatever measures are thought to be appropriate, output issues should have been addressed in the report, or at least there should have been a call for some studies to provide this kind of information.

Furthermore, in addition to the question of an adequate output, problems can also arise in regard to the effective diffusion into industrial use of the technology that has been developed. With Australia not having much in the way of a petrochemical or agrochemical industry, or indeed a pharmaceutical industry, where will all the biotechnology products go? In the report under review all these questions have not been addressed at all.

As it is, the report's suggestions for the future are banal and predictable: let's have more of the 150 per cent tax deduction; more MIC investment; and biotechnology should be declared a priority area within the GIRD scheme, by the Australian Research Council and by CSIRO. Furthermore, the Consultative Group recommended that the role of CSIRO should be to conduct long term projects and to maintain a watching brief "on overseas developments in basic biological science of potential commercial importance". This would seem to fall somewhat short of the government's current view that CSIRO needs to have "a stronger commitment to the effective transfer of its results to users".[2]

And so the Biotechnology Consultative Group's report is solidly grounded in the common wisdom of scientists when it comes to science policy: fund the scientists better; regulate them less; allow them to decided what to research; and do not assess their output straight away. All will then be well and their research will be applied appropriately. Modern industry policy has, of course, moved well beyond these simplistic science-based prescriptions. But in *Biotechnology in Australia* there is not much evidence of such a move to a more sophisticated analysis.

REFERENCES

1. David Blumenthal *et al.*, 'Industrial support of university research in biotechnology', *Science*, 231, January 1986, p. 244.
2. *Science and Technology Statement 1987-88*, AGPS, Canberra, 1988, p. 117.

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