Biotechnology in Australia – Supplementary Report

1982
BIOTECHNOLOGY IN AUSTRALIA

A SUPPLEMENTARY REPORT TO THE PRIME MINISTER

BY THE

AUSTRALIAN SCIENCE AND TECHNOLOGY COUNCIL

(ASTEC)

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My dear Acting Prime Minister,

BIOTECHNOLOGY IN AUSTRALIA

We have the honour to present to you a report on appropriate areas for exploitation of biotechnology in Australia. This report is supplementary to the ASTEC report 'Biotechnology in Australia' which was forwarded to you on 8 November 1982 and uses, as a basis, the results of a workshop recently convened by the Minister for Science and Technology.

Yours sincerely,

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INTRODUCTION

1. In May 1982, the Prime Minister wrote to ASTEC noting the Council's intention to report on prospects for biotechnology in Australia and seeking inclusion in the report of an examination of the most promising areas for research in Australia, the most appropriate way to fund this research and the level of support necessary.

2. ASTEC presented its report 'Biotechnology in Australia' to the Prime Minister on 8 November 1982. The report noted the increased opportunities available to Australia from recent developments in biotechnology and made recommendations on how best to take advantage of these opportunities. The Council noted that it had no special competence to select the most promising fields of activity in biotechnology. However, it undertook to provide the present supplementary report on the most appropriate areas for exploitation of biotechnology in Australia, using as a basis the results of a workshop convened for this purpose in November 1982 by the Minister for Science and Technology. This workshop and the supplementary report confirm the view expressed in the earlier ASTEC report on biotechnology that, with careful selection and concentration of effort, research developments in biotechnology in Australia can be of considerable commercial benefit to Australia. The general areas in which these benefits are most likely to occur are plant agriculture, animal husbandry, and the development of water treatment and water recovery systems. Advantages are also seen for the use of novel biotechnology techniques in the production of carefully selected pharmaceutical, veterinary, and chemical products and in the food processing industry.

THE BIOTECHNOLOGY WORKSHOP

3. In November 1981, the Minister for Science and Technology convened a symposium in Sydney on the commercial opportunities for genetic engineering in Australia. This symposium brought together industrialists, researchers and government employees to discuss the full range of potential applications of biotechnology. This meeting was intended primarily as a means of promoting commercial interest in the area, but no attempt was made to assess critically those aspects of biotechnology most relevant to Australia. The Minister convened a more concentrated meeting in Canberra in November 1982 which brought together scientists and industrialists, including market specialists, to identify those research areas and applications of biotechnology which hold the greatest promise for industrial and agricultural exploitation in Australia.

4. During the November 1982 workshop, the participants indicated that there were a number of considerations which had to be taken into account in any assessment of appropriate areas for commercial exploitation of new biotechnology techniques in Australia. These included:
the level of research competence and experience;
- the adequacy of Australian research resources and expertise to develop new products and processes;
- the extent of interaction between the research and industrial sectors;
- the suitability of products and processes for Australian manufacture or application including the resources and expertise of Australian industry to assess and complete commercial development, and the availability of finance;
- the adequacy of local and overseas markets to support Australian industrial activity; and
- the time expected to develop an Australian commercial activity.

5. It was also noted that while some areas of biotechnology can be exploited effectively by commercial organisations, other areas of considerable economic importance to Australia cannot be as readily exploited on a purely commercial basis. For example, in some areas of agriculture, few Australian companies are in a position to appropriate the full benefits of research results in plant breeding and animal husbandry. It is therefore unlikely that companies will support such research until the commercial viability of research results is readily apparent.

PRIORITY AREAS

6. ASTEC has used the discussions at the Biotechnology Workshop as the main basis for the following comments on priority areas.

Plant Agriculture

7. The application of novel biotechnology techniques to plant agriculture is most promising. Australian biotechnology research in agriculture is already well advanced, there are established firms and extension systems for translating research results into the field, and there is a strong demand for any processes which increase the efficiency of Australian agriculture.

- The use of plant tissue culture and cell fusion techniques to create and maintain disease-free plants and to improve plant species will have a noticeable impact on Australian agriculture in the short term. Some important applications are already being used by commercial organisations in Australia.

- Genetic engineering to improve plant species by the addition of new genes from other species should be of great importance in the longer term for the production of crops and pastures with improved disease resistance, drought and salt tolerance and greater productivity. Potential also exists to modify soil microbes by genetic engineering for the improvement of soil fertility and greater efficiency of fertiliser use.
The development of diagnostic probes for viral disease and of control agents such as selective weedicides are important activities. Australian research capability is well developed but the limited Australian market for probes and the lack of Australian manufacturers of new weedicides suggest that the potential for commercial exploitation is not high.

Animal Husbandry

8. Considerable opportunities for commercialisation or exploitation of biotechnology techniques exist. The livestock production industry in Australia is well supported by an effective research and technology transfer infrastructure in which CSIRO, university and Commonwealth and State Departments form an effective network to transmit knowledge and new developments directly to producers. The importance of animal husbandry to Australian agriculture ensures a continuing strong demand for any improvements resulting from the application of genetic engineering to animal breeding, new advanced breeding techniques, the development of new hormones, and the improvement of rumen micro-organisms.

- The application of advanced breeding techniques such as super-ovulation and embryo transplants is already having an impact in improving animal quality and production.

- The application of genetic engineering to animal breeding requires more research and development and is unlikely to influence animal production significantly for at least another decade. This area should receive high priority support from government.

- The development of hormones for use in animal husbandry may require a long lead time but should receive priority support.

Veterinary Products

9. The production of veterinary pharmaceuticals has significant potential for commercial exploitation in Australia. A major consideration in this exploitation is the cost of production of veterinary goods using novel biotechnology techniques in comparison with existing well-established chemical procedures.

- The research base in Australia for viral, bacterial and parasite vaccines is extremely strong but there are some difficulties relating to the production of, and market demand for, these products. The demand for new products made in Australia will depend on the efficacy of available alternatives marketed by multinational veterinary companies, on the extent of protection afforded by vaccines compared to chemical drenches, and on the cost of the product in comparison to the cost of livestock being treated. With careful selection, some Australian companies are developing useful markets in Australia for animal vaccines and research work in this area should be supported.

- Research on and production of novel probes and antibodies for diagnostic use are well advanced in Australia and there is potential for considerable market penetration because of the ease and low costs of production of these compounds.
Low priority is accorded to the development and production of antibiotics using biotechnology because of the strong position of overseas veterinary companies in Australia.

Waste Treatment and Utilisation

10. Because of the importance of water in Australia and the need to restrict pollution caused by industrial and mining wastes, research, development, manufacture and marketing of water treatment and water recovery systems is accorded high priority.

- There is considerable potential in Australia for the development of water treatment or water recovery systems especially for sewage and heavy metal extraction. Research in this area is undertaken in the tertiary education sector, CSIRO and the private sector, and the manufacture of appropriate systems has already proved profitable. There is an increasing demand for water treatment systems on the basis of the importance of water in Australia and localised pollution problems. In addition, Australian industry is giving serious consideration to systems for removing heavy metal and chemical waste from industrial effluents.

- There is a high level of research in waste utilisation in Australia; however for economic reasons, opportunities for commercialisation are restricted.

Food Processing

11. Research and development, manufacturing and marketing are well developed in the baking, brewing, cheesemaking and wine-making industries. The standard of product in these industries is already high and there appears to be little demand for the application of novel biotechnology techniques for further improvements, except in the cheesemaking industry.

- There has been considerable research overseas into the use of new biotechnology techniques to produce single cell proteins, sweeteners, flavours, fragrances and other additives. In Australia, the research, manufacturing capacity and market penetration of Australian firms is not sufficient to warrant priority being given to this area for commercial exploitation.

Human Pharmaceuticals

12. Australian research on immunoproteins and diagnostic probes is of high standard and adequate facilities and markets exist for their production. This is one of the few areas where Australian research expertise in biotechnology is already assisting commercial ventures. These endeavours should be supported and in time they could form the basis of an Australian pharmaceutical industry.
While research on protein hormones is world class, it is unlikely that any Australian company will have the financial resources to support the testing of new hormones for human use. The production of hormones in Australia is therefore unlikely and commercialisation of Australian research results will arise from licensing of production to international pharmaceutical companies.

The production of non-protein hormones, enzymes and antibiotics is not rated highly because of limited Australian research capacity, manufacturing capability and market penetration by Australian firms.

Chemical Industry

13. The manufacture of chemicals has been the subject of considerable scrutiny by biotechnology companies overseas. It has been shown that biotechnology techniques, particularly the modification of micro-organisms, can be applicable to the manufacture of a wide range of chemicals including those of low value and high volume (alcohols), intermediate value and high volume (amino acids) and high value and low volume (antibiotics, enzymes and vitamins). While some research expertise in all of these areas exists in Australia, economic problems associated with production in Australia and with competition against large efficient overseas chemical companies lead to a low priority being accorded to the application of biotechnology to the chemical industry. Despite this, the production of a few selected chemicals in Australia using novel biotechnology techniques might be economic.

Mining

14. There may be opportunities for the utilisation of new biotechnology techniques in the Australian mining industry because of its economic importance. However, with few exceptions, the economies of many biotechnology processes will not be favourable for some time. Exceptions may be in the use of micro-organisms in the leaching of ores from depleted mine workings and in mineral beneficiation. These activities are likely to be of very limited economic importance because of the availability of concentrated ore bodies which can be worked by conventional methods.

Biotechnology Support Systems

15. There is a need for promoting biotechnology support systems in Australia as this is an area which has been neglected. Because of the importance of biotechnology to future economic development in Australia, some improvement, particularly in the manufacture of specialised biological reagents, of selected instruments and of fermentation equipment is considered important. Expertise already exists in Australia and firms specialising in small batch production of instruments are commercially viable. Large-scale production is likely to remain the preserve of larger countries such as Japan and America. Because of this, it is considered that development in the area of biotechnology support will rely heavily on individuals, entrepreneurs and a close relationship between research groups, instrument suppliers and manufacturers.
FUTURE PRIORITIES

16. Priorities for Australia will change as scientific and technological advances are made, and as changes occur in industries and markets. The priorities proposed in this supplementary report will therefore require regular review, a task which should be the responsibility of the proposed Advisory Committee of the National Biotechnology Scheme.