AUSTRALIAN ACADEMY OF SCIENCE

SUBMISSION

To the House of Representatives Standing Committee on Primary Industries and Regional Services inquiry on

THE DEVELOPMENT OF HIGH TECHNOLOGY INDUSTRIES IN REGIONAL AUSTRALIA BASED ON BIO-PROSPECTING

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1. The contribution towards the development of high technology knowledge industries based on bio-prospecting and related bio-technologies

Bio-prospecting remains a major potential source of discovery of new molecular types and structures given that less than 20% of Australia's flora has been investigated. There is a critical need for new bio-active structures in the development of pharmaceuticals, veterinary medicines and agrochemicals. Also, there is rapid build-up of resistance towards many current antibiotics used in the human and veterinary medicine fields. Natural (ie non toxic) treatments are needed against the pests that devour the world's food crops, especially since genetically-modified foods are not meeting widespread acceptance world wide.

Australian research institutes involved in research on bio-prospecting, include the Australian Institute of Marine Science (AIMS), University of Melbourne, University of Queensland, the Key Centre for Biodiversity and Bio-resources at Macquarie University, The Pharmaceutical Research Institute at Griffith university, AMRAD, and Biodiscovery.

Given the diversity of Australia's flora and fauna, it is important that a well resourced collection and repository system is developed. This system must have international credibility involving natural history museums and universities working in tandem with commercially orientated activities. Good models of such collections exist in Australia. The AstraZeneca Research Institute formerly known as the Queensland Pharmaceutical Research Institute at Griffith University and Mt Gravatt Research Park (Professor Ron Quinn) work closely with the Queensland Museum, AIMS and the University of Queensland.

Universities provide an additional or alternative source of collection and extraction of active ingredients. Associate Professor Rob Capon, University of Melbourne, extracts novel chemicals from southern marine sponges, while the 3D centre, University of Queensland is another model of university led collectors who also purify and extract novel peptides from cone snails collected from the Barrier Reef. AIMS has a well developed database offering

many novel chemicals for screening biological activity. These data bases may be offered to large pharmaceutical companies under commercial agreement.

2. Impediments to growth of these new industries

These new industries would require capital investment by companies, and in the case of bio-processing would also require the provision of infrastructure by government. The main impediment has been the lack of vision and forward planning by both government and industry.

At present there is no nationally-consistent policy with respect to bio-prospecting. Since organisms do not respect political (state v. commonwealth) boundaries, there is a need for a national policy so that states do not attempt to compete with each other in attracting capital investment.

A single nationally developed set of guidelines which facilitate application and approval of permits for Australians to collect and research our bio-diversity is desirable. These guidelines should be transparent and straightforward to implement.

Guidelines and/or regulations should be designed not to impede the preliminary investigation of the biotechnological potential of our bio-diversity. Different sets of regulations should address the needs of

(i) pure (academic) research
(ii) academic research with some commercial potential and
(iii) commercially-orientated research.

The materials and intellectual property flowing from discovery needs to be properly protected for the benefit of the region, and ultimately Australia through universities, museums, CSIRO and government.

The development of Australia's bio-diversity by or on behalf of commercial users must be sustainable. This can only be achieved through ongoing intensive and exploratory research into the growth and/or maintenance of organisms either *in situ* or *in vitro*. Industry and government sectors need to provide adequate funding for this research work.

In 1991 the Academy organised a symposium titled *Australia's Biota and the National Interest*. [i]The symposium made a number of recommendations to revitalise our ailing taxonomic workforce and to address decreasing numbers of training of new taxonomists being trained.

The recommendations included a need for more post-graduate scholarships for post-doctoral study as well as post-doctoral and senior research fellowships to provide a career structure to retain the expertise gained. Since then the situation has deteriorated further.

A 1998 study of Australian microbial resources found that there was an urgent need for a national review of culture collections of micro-organisms and

genetic resources in Australia. It was found Australian culture collections lack the minimum critical staff numbers and resources to provide the services required by users in the science, technology and industry sectors.[ii]

Important impediments are the,

- lack of government support for related university disciplines
- shortage of staff and essential infrastructure
- lack of awareness by government and others of the essential lead time involved, and
- potential biopiracy issues

3. The capacity to maximise benefit through intellectual property rights and other mechanisms to support development of these industries in Australia

The discovery of a novel chemical lead that may offer a suitable starting point for the development and commercialisation of new drugs is the key driver for bio-prospecting. There are many examples of drugs directly extracted from plants that are effective therapeutics. A recent example is the Tasmanian poppies modified for morphine (Glaxo SmithKline). Australia's discovery pool also includes venoms from a variety of snakes, spiders and jellyfish. The aim is not just to develop better treatments. By isolating the toxin components, new chemical leads may arise. From two fish eating cone snails, *conus magus,* and *conus catus,* have come two very potent peptides, one developed by Neurex and a similar peptide discovered, and now synthesized at the 3D centre at University of Queensland in partnership with AMRAD. Both these peptides are no longer extracted from the snails but are prepared by synthetic chemistry. These peptides are in different stages of clinical trial for the treatment of neuropathic pain.

It is not feasible to predict the financial benefits from particular intellectual property rights from bio-prospecting or bio-processing. Such benefits cannot be analysed to determine whether or not the initial investigation and research is worth doing. However, the prospects for important outcomes are enormous, given Australia's natural bio-diversity and high level research skills. If Australia does not seize the opportunity to gain what benefit there is, then other countries will, and we shall become even more dependent on buying future technology from others.

Under license, the commercial enterprise may take the material for extraction and further identification of active principals. A 'first right' of development by private industry ought to be a privilege (not a right) for resourcing and enabling the original collection of novel material.

This collection could provide a very limited amount of raw (natural) material; and it may be very difficult to replicate the original sample due to the isolation of the collection site, seasonal effects or just natural scarcity. However, having very limited material may not be as important as it once was given the very powerful and sensitive multi-plate assays and robotic screening techniques now available.

Once the material has been collected, a series of extraction procedures follows before an interesting molecule is identified. High throughput screening against a bank of receptor probes at this point may identify a molecule for further investigation. The next steps in the discovery process could occur anywhere in the world. Choice will depend on the company, the location of the major research base and expertise. For example the AstraZeneca research facility at Griffith, Qld is directly linked to its research and screening facilities in Astra Hassle, Sweden and AstraZeneca Charnwood UK.

As far as possible, intellectual property rights associated with the development of Australia's bio-diversity should stay within Australia so that the benefits accrue here rather than overseas. In many instances this can be achieved through careful licensing arrangements.

4. The impacts on and benefits to the environment

There is tremendous scope in Australia for bioprocessing industries based on our expertise in agriculture and chemistry. The industrial production of important chemical feedstock is increasingly focusing on bioprocessing because of the greatly reduced impact on the environment. An example would be the production of adipic acid (for nylon) from agricultural crops, with genetic modification to give improved yields of the desired compound. Such production would be preferable to the current chemical synthesis which requires the removal of toxic nitrogen oxides.

Aquaculture and shipping represent other industry sectors which have much to gain from bio-prospecting within Australia. The fouling of built marine structures (ships, aquaculture nets, pipes etc) is a major economic problem costing over $6.4 billion dollars per year worldwide. Many marine organisms naturally produce anti-foulants.

Another example of the potential value of such microbial resources was the discovery by a CSIRO researcher in a herbicide-polluted site in Western Australia of a new strain of a common soil organism, Pseudomonas. The organism has three unique genes that enable it to digest a highly toxic and soil-persistent pesticide (atrazine) that is widely used in agriculture. This ability has wide applications to cleaning spills and residues in contaminated soil and ground water.

There are no negative impacts on the environment either from bio-prospecting or bio-processing, provided that the renewable resources are allowed to re-establish themselves. If important new chemicals were found, they would either be synthesised, or obtained by extraction from specially planted crops (the former being most likely). Once again it is worth emphasising that the initial research will have no negative impact, and it is only after an important discovery is made that any future environmental impact of production can be evaluated.

A hidden benefit of bio-prospecting is the ongoing discovery of new species, adding to the store chest of knowledge about Australia's bio-diversity. Additionally study of the fundamental biology of rare plants, animals and their habitats leads to better defined knowledge on how to protect these species and their selected habitats.

The Way Forward

The collection and classification of material is not sufficient for real economic benefit from bio-prospecting to follow.

Success depends on all the elements found in academic, commercial and government enterprises working together. The research is high risk, and long term. It requires excellent talent prepared to work in collaboration for the task at hand.

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[i] Australian Academy of Science *Australia's biota and the national interest: the role of biological collections.* November 1991

[ii] Lindsay I Sly Australian Microbial Resources Department of Microbiology, University of Queensland