
Australian biotech companies: Navigating the maze

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Abstract

Australia is largely accepted as an active biotech nation and claims the sixth position globally in the industry. A recent survey of the Australian biotechnology industry reported 370 biotechnology and 600 medical-device companies, most, if not all, products of Australia's academic research initiatives. The country presents a unique biotechnology landscape dominated by seed-stage companies and a handful of larger companies with validated technologies and/or products in development. The reason for this skewed distribution lies, in part, in Australia's funding infrastructure. This is characterised by a large and high-quality academic system that derives applied research support from numerous government incentives for seed funding without a critical mass of downstream venture capital or other financial support to fund continued growth. The unique challenges faced by Australian companies, such as visibility, distance to key markets and potential commercial collaborators and lack of development funding, have resulted in a number of strategies being implemented. These include efforts to raise money, often prematurely and very discounted, through public markets in Australia and/or partnerships around very early, very high-risk development-stage projects with US/European pharmaceutical or biotechnology companies. In addition, a recent strategy has been to merge with or acquire another Australian or overseas small company.

INTRODUCTION

Australia's biotechnology industry is unique in many ways. The country cites 370 companies in the biotechnology sector and up to 600 in the medical device area.¹ It is ranked among the top biotechnology nations in the world and first in the Asia-Pacific region on a number of metrics (skilled labour force, availability of R&D personnel, ranking of scientists and engineers, rate of domestic and international alliances in Organization for Economic Cooperation and Development, OECD, countries). Australia offers a fertile and receptive intellectual ground for biotech companies. It has a strong academic system with particular expertise in natural products, medicine, veterinary science and agriculture. Stem cell research is also an area of strength and has been identified as a core competency by Australia's Federal government. The Australian government's support of R&D compares favourably with other OECD nations in

terms of percentage of gross domestic product (GDP). Additionally, the government provides a variety of incentives for companies to establish research and progress development in Australia and to commercialise and export technology, products and services. The country also offers one of the lowest establishment and operation costs in the western world for a biotechnology research centre. According to an Ernst & Young, Hay Group and SRI benchmarking survey of biomedical R&D costs, Australia is the country with the lowest costs in a group of 15 nations for the establishment and operation of a 30-person biotech business (in an aggregated assessment, including salaries, costs for a diverse range of staff, typical laboratory set-up and running costs).² For all these reasons, many multinational pharmaceutical companies have invested in significant collaborations, both academic and applied, with Australian institutions (see Table 13 for examples).

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This paper aims to provide a road map to the Australian biotechnology landscape. The first section briefly describes the Australian biotech playing field by outlining the key academic institutions, government programmes and sources of funding. The second section presents representative companies grouped by therapeutic areas. The last section presents and discusses some of the key strategic challenges that are typical for Australian companies.

AUSTRALIAN BIOTECHNOLOGY LANDSCAPE

Of the 370 biotechnology companies reported in Australia, the majority (43 per cent) are focused on human therapeutics, followed by agribiotech (17 per cent) and diagnostics (15 per cent), with suppliers, chemical, environmental and others making up the remaining 25 per cent.¹ An evaluation of the companies in human therapeutics reveals numerous seed-stage companies, with only a small number of well-established biotech companies (see Table 7). This distribution has evolved from an imbalance between early and later stage funding: a large and high-quality academic system receives government incentives for early seed funding, but without adequate downstream capital to fund the gap between seed funding and public market requirements.

Australia's academic system and innovation

Australia has a structured and well-funded academic system, which is almost entirely funded by government. Historically, Australia has had an enviable investment in R&D as a percentage of GDP, spending 1.4 per cent of GDP for overall research and development.³ Higher education research and development, as a percentage of GDP in 2000 was 0.41 per cent, which compared favourably with other OECD countries, and is higher than figures recorded for Germany (0.40 per cent), the USA (0.37 per cent) and France (0.36 per cent). The emphasis on

biotechnology in government funding is growing, with the biotech public and not-for-profit expenditure on R&D reaching 20 per cent of the total government (Federal and State together) R&D spend in 2000.¹

The standard of Australian science is world class, and demonstrable by the publication and citation records of Australian scientists. A useful national comparison is the success of Australian scientists in securing National Institutes of Health (NIH, United States) funding through the agency's foreign grants programme,⁴ ranking third (US\$20m) against Canada (US\$48m) and the UK (US\$35.5m).⁵ The relative level of NIH-funded collaborations between Australian and US scientists (more than 90 as compared with approximately 120 between Canada and the USA)⁵ also reflects favourably on Australian science and its relevance to the health and medical focus in the USA.

The Australian academic system comprises four types of academic centres:

- Universities (40 in total).
- Research institutes and centres of excellence, hospitals.
- Cooperative research centres (CRC): 71 centres (31 of which claim biotechnology, nine in health and medical) set up as joint ventures between government institutions (university, research institute or Commonwealth Scientific and Industrial Research Organization, CSIRO) and industry to bridge and develop scientific innovation into commercial products.
- CSIRO: network of government-funded applied-research centres comprising 3,300 scientists across all industries that include healthcare in approximately 60 sites.

These academic institutions are the source of many spin-off companies; in the

Most of Australia's 370 biotech companies are at the seed stage

Australia benefits from a world class and well funded academic system

period July 2002 to July 2003, two-thirds of all start-ups arose from research institutes.¹ Table 1 lists a representative sample of key university and research institutions along with the companies that have emerged from their work. Table 2 lists biotechnology incubators in Australia and their affiliations.

AUD\$200m per annum from July 2004 to June 2011. The programme replaces the Start and Biotech Innovation Fund (BIF) programmes, to provide partial funding for up to 1700 small and medium-sized businesses across all industries for early stage commercialisation activities, R&D and proof-of-concept in projects with high commercial potential. There is no preset distribution of this funding across the industries covered.

The Australian government provides a variety of programmes to fund seed stage companies & early applied research

Government incentives

The Australian government provides a variety of financial incentives both to fund basic/early applied research and for academic researchers to set up a seed-stage company to further develop the resulting intellectual property. Some of the key programmes⁶ include:

- Pharmaceutical Partnership Program (P3 program, successor of PIIP program) – the most recent in a series of government incentive programmes to support life science development. The government provides 30 cents on every new R&D dollar, up to AUD\$10m spent by selected qualified and approved companies. Table 3 lists 2004’s recipients of the programme.
- Commercial Ready Program – of
- Commercializing Emerging Technologies (COMET) – an existing programme in place until 2011 to support up to 200 small companies per annum, irrespective of industry. Companies are selected for their ability to attract investment and grow rapidly through commercialisation of highly innovative products, processes and services.
- Pre-Seed Fund – fund of AUD\$101m of which AUD\$78m are government funds for university and public-sector research. The fund is managed by four Australian venture capital firms (GBS Ventures, Starfish Ventures,

Table 1: Representative Australian academic institutions and spin-off companies

Institution	Description	Spin-offs
Monash, Melbourne	Large university, member of the group of eight, with 75 research centres and 17 cooperative research centres	Cortical, Metabolic, Meditech Limited, Acrux, Kinacia, Copyrat, IngenKO
University of Queensland	Large university, member of the group of eight	Promics, C-Bio, Alchemia, QrxPharma, Kalthera
University of Sydney	Large university, member of the group of eight	Novogen
Austin Research Institute, Melbourne	Research institute focused on immune system, cancer, infectious disease and transplantation	Arthron, CancerVac, Panavax, Oncomab
Queensland Institute of Medical Research, Brisbane	Medical research with focus on immunology, infectious disease and cancer. 700 scientists	Adipogen
John Curtin School of Medical Research, Canberra	Part of the Australian National University. Fundamental research that underpins the practice of medicine	Biotron, Virax, Progen
Ludwig Institute for Cancer Research, Melbourne	Worldwide network of ten branches in seven countries dedicated to basic and clinical cancer research	Cytopia
Garvan Institute, Sydney	Gene-based medical research. Affiliated with St. Aza, G2 Therapies Vincent’s Hospital	

Table 2: Representative Australian biotechnology incubators

Incubator	Affiliation
Xcelerator Ltd, North Ryde ATP Innovations, Eveleigh	North Ryde Bio Hub, NSW Australian National University, University of Sydney, University of New South Wales, University of Technology Sydney University of Melbourne
Bio21 Biotechnology Business Incubator, Melbourne Thebarton Biosciences Incubator, Adelaide	University of Adelaide
Victorian AgriBiosciences Centre, Bundoora.	La Trobe University

Source: Invest Australia.

SciVenture, Allen & Buckeridge).

- Pooled Development Funds (PDFs) – from 1992 up to 30th June, 2003, PDFs raised over AUD\$700m and invested about AUD\$550m in more than 435 companies across all industries. Investment attraction was via taxation incentives, particularly concessional income tax treatment and capital gains tax exemption in the hands of investors. These investors in turn provided a pool of funds which specialist managers invested in companies with total assets of AUD\$50m or less.
- Venture Capital Limited Partnerships (VCLPs) are a result of legislation in
 - R&D Tax Concession is an ongoing

December 2002 to attract non-resident capital for investment across the whole spectrum of venture capital opportunities, including later-stage investments and management buy-outs. A tax exemption applies to the profits from the VCLP investments in their eligible investee companies (ie Starfish Ventures' new VCLP Starfish Technology Fund I, at AUD\$62.5m).

Table 3: 2004 recipients of grants in the P3 program

Company	Activity	Amount (AUD\$m)
Acrux DDS Pty Ltd	Transdermal drugs	4.2
AGT Biosciences Ltd	Gene discovery for novel targets	8.4
AMRAD Corporation Ltd	Drug discovery in allergy and inflammation	5.2
Eli Lilly Australia Pty Ltd	Collaborative R&D with academic and biotech companies	10
Janssen-Cilag Pty Ltd	Phase II and III clinical trials	5.4
Mayne Pharma Pty Ltd	Generic and Injectable specialty pharma	10
Merck & Co. (Australia) Pty Ltd	Collaboration with AMRAD and CSL and clinical trials	10
Novogen Ltd	Anti-cancer agent in Phase II	10
Pharmaxis Ltd	Respiratory disease drug discovery	6.1
Servier Laboratories (Australia) Pty	Collaborative R&D projects with Australian companies and Phase II and III clinical research	7.8
CSL	Large Australian vaccine company	10

Source: Australian Government Program.⁶

broad-based, federal incentive that any company with taxable income can apply for, allowing deduction of qualifying R&D expenditure (includes a R&D Tax Offset, 175 per cent R&D Premium Tax concession and effective life treatment for R&D plant).

- Export Market Development Grants (EMDG) – the Australian Government’s principal financial assistance programme for aspiring and current exporters. Administered by Austrade (Australian Trade Commission), the programme encourages small and medium-sized Australian businesses to develop export markets by reimbursing 50 per cent of their export development costs. In the 2002–03 financial year, AUD\$143.9m was reimbursed to 3,843 businesses.

There is a lack of critical funding between the seed stage and the public capital market

Capital market

Many of the government incentives readily provide seed funding for the conversion of academic research to an early commercial product. There is, however, a lack of critical funding

between seed funding and the public market to support building value through scientific validation and successful partnering. Available venture capital (VC) is largely Australian and, as a result, is limited. To obtain the critical mass of funding required to validate technology or products, overseas venture investment is required, or more commonly, Australian companies access the public initial public offering (IPO) market, at valuations far below their Western brothers and sisters, for these funds.

Table 4 provides a list of the key venture capital firms that invest in life science companies. The largest firms manage funds in the AUD\$100–200m range, which is almost ten times smaller than the largest US VC firms (for example US funds such as Alta Partners, Healthcare Venture, MPM manage well over US\$1bn in funds). These VC firms tend to be limited in their financial ability to support extensive investment portfolios, or to make a commitment for serial follow-on funding required for success in this industry. A relatively small number of Australian biotech companies rely on VC funding, and many use

Australian companies access the IPO market earlier and at a lower valuation than their US or European counterparts

Table 4: Representative list of Australian life sciences venture capital funds

VC firm	Fund ^a	Portfolio companies
Biotech Capital	50	Proteome Systems, XRT, Xenome, C3, Stem Cell Sciences, Alchemia
Medica Holdings	10 ^b	Alchemia, Cytopia, Xenome
GBS	137 ^c	Alchemia, Cerylid Biosciences, CogState, Cortical, Kinacia, Novasys, Pharmaxis Pharmaceuticals, Phenomix, Promics
CM Capital	110	Pharmaxis, Alchemia, Cerylid, Phenomix
CHAMP Ventures	42 ^d	G2 Therapies Ltd, EnGenIC Ltd, Alchemia
Innovation capital	36	Enterix, QrxPharma, Neuromonics
Queensland Bio Capital	100	Xenome, Glykoz
Sciventure	230	Chirogen
Startup Australia	55 ^e	Kinacia, Alchemia, Promics, Evogenics, Protagonist, Mimetica, Iliad, Cortical
Uniseed	20	Adipogen, Calibre Biotechnology, Combinomics, Chirogen, Cryptopharma, Hepitope, Pargenex, QrxPharma, Radical, Thrombostat
Nanyang Ventures	150	QRxPharma
Starfish Ventures	140	NeuProtect, TeeleOstin

^a Fund in management as of June 2004 in AUD\$m.

^b Registered Pooled Development Fund. Represent total assets (current + investments). Source: Medica half-year report for 2004.

^c Combination of three funds: the Australian Bioscience Trust (AUD\$42.5m) fund raised under the Australian Federal Government’s Innovation Investment Fund (IIF) program, GBS Bioventures II (AUD\$64.5m) and The Genesis Fund (AUD\$30m) raised under the Australian Federal Government’s Pre-Seed Fund (PSF) program.

^d Corresponds to CHAMP Ventures AMWIN fund dedicated to early stage investments.

^e In process of raising another AUD\$70m fund.

In 1998–2002 Australian public biotech companies share price significantly outperformed the share price of US public biotechs

private/angel or government funding for the initial round and then raise money, sooner rather than later, by going public on the Australian Stock Exchange (ASX). For example Peplin went public in 2002 when the company was two years old with only preclinical data supporting their lead compound. It raised AUD\$4.3m at AUD\$0.65 a share. Table 5 compares US and Australian IPOs with regard to the amount of money raised, market valuation and percentage of the company given away. On average, Australian biotech companies go public at a tenth of the valuation of their US counterparts and also raise a tenth of the amount. It is common for Australian companies to be listed on the ASX with a stock price below AUD\$1 and a valuation below AUD\$60m.

Australian biotech IPOs have collectively had a somewhat distinct experience from other sectors and the global experience, through the market slump of recent years. Table 6 compares the performance of Australian biotech

companies with US biotechs and Australian non-biotech companies. For the period 1998–2002, these new Australian public companies significantly outperformed (+67 per cent) US biotechs (–47 per cent), Australian non-biotech IPOs (–36 per cent) and the ASX as a whole (–5 per cent).⁷ However, a third of the newly listed biotechs had less than a year of available cash and expected relatively poor prospects for additional raisings on the public markets in their near-term future. The 24 companies in the group studied raised only AUD\$88m pre-IPO of which five companies had secured VC investment averaging AUD\$6m each.

As of June 2004, there were 66 biotech companies listed on the ASX, out of a total of 120 firms in the Healthcare and Biotech Index. In 2003, nine new companies listed on the ASX raising only AUD\$113m.⁸ At the close of the Australian financial year on 30th June, 2004, Intersuisse's biotech portfolio of about 70 Australian biotechnology, life science and medical device stocks reported its best year (+24 per cent) since the technology boom, with the combined share prices outperforming the All Ordinaries Index (+18 per cent) and the NASDAQ biotechnology benchmark (+13 per cent).⁹

AUSTRALIAN BIOTECHNOLOGY COMPANIES

The Australian biotechnology industry is largely made up of private early discovery seed-stage companies working to validate their technologies to attract downstream investment and partnerships to support development of their products worldwide.¹⁰ Of these, approximately 215 companies are in human therapeutics, diagnostics and services for human diseases covering the areas of systems biology, immunology, oncology and neuroscience as the prime areas of focus. Most recently, stem cell research was embraced by government as an important national area of focus and competency.

Table 5: Comparison of ASX biotechnology IPOs with samples of others

Characteristics at IPO	ASX biotech (AUD\$m)	ASX non-biotech (AUD\$m)	US biotech (AUD\$m)
Amount raised	10.5	28.3 (13.4) ^a	119
Market cap	39.2	69.1 (33.4)	525
Firm sold (%)	31.7	41.8	22.7

^a Values with two very large non-biotech IPOs removed.
Source: Sparling and Vitale.⁷

Table 6: Comparison of share price performance from IPO to 23rd May, 2003

Performance indicator	ASX biotechs	ASX non-biotech sample	US biotechs
Number of IPOs	24	48	90
Average return	67	–36	–45
Losing money (%)	70	75	82
Doubled (%)	17	8	1
Acquired, suspended or delisted (%)	4 ^a	21	9

^a The shares of one company, Analytica, were suspended from trading for a time, but following a reorganisation the company's shares resumed trading.
Source: Sparling and Vitale.⁷

Table 7: Top 12 biotech companies by market capitalisation

Company	Key products/services	Market cap
CSL	Marketed: 26 pharmaceuticals in analgesia, antibiotics, dermatology, emergency care, gynaecology, neurology and urology. 33 vaccines and antivenoms Late stage research: peptic ulcer vaccine against <i>Helicobacter pylori</i> and <i>Papilloma</i> virus vaccine for genital warts	3,991
Novogen	Phenoxodiol (NV-06): Anticancer, Phase II Marketed over-the-counter products for men and women's health	612
Peptech	Animal health products: Suprelorin: suppression of reproductive function in dogs, Ovuplant: device to stimulate ovulation in mares	256
Metabolic	AOD9604 anti-obesity, Phase II	179
Sirtex	SIRsphere: marketed anticancer DoxSphere: anticancer in Phase II	147
Norwood Abbey Genetic Technologies	Drug delivery DNA testing	146 129
pSivida	Nano-structured porous silicon technology for drug delivery	121
Progen Industries	PI-88 anticancer in Phase II PI-166 anticancer in Phase I	117
AMRAD	AM336 for chronic severe pain in Phase II AM36 for the treatment of stroke in Phase I	92
Starpharma	Vivagel: prevention of HIV infection, Phase I	88
Epitan	Melanotan for sunburn injury, Phase II	83

Ranked by market capitalisation in AUD\$m. Excludes investment companies.
Source: Bioshares.

Australian biotech companies continue to suffer from the small size of the market, the lack of growth capital and experienced entrepreneurs

The group is dominated by a small number of more established public companies. Table 7 lists the top 12 public companies by market value as of April 2004. Most of these companies are characterised by a portfolio of marketed products and/or drugs in Phase II/III clinical trials. For example Metabolic, Novogen, Progen and Epitan all have products in Phase II clinical trials.

The three therapeutic areas for Australian companies that stand out are oncology, inflammation and neuroscience. Tables 8–10 list

Table 8: Representative oncology companies

Company	Product/services	Market cap
Peplin	PEP-005 protein kinase C inhibitor in Phase I	64
Cytopia	Preclinical programs in cancer and immune disease	— ^a
Solbec	SBP002/BEC Natural product anticancer in Phase I	23
Australian Cancer Technology	Pentrys: cancer vaccine in phase II	30

^a Private company.

representative companies in these three areas. Some Australian companies are also involved in the cardiovascular, metabolic disease and virology areas; a representative sample is listed in Table 11.

In the platform technology area, Australian companies are present in many of the technologies for drug discovery, and stem cell research has been put forth by government as a particular technology in which Australia enjoys a leadership position and an area for vigorous development. Table 12 lists some of the key platform technology companies, including some of the drug delivery companies.

STRATEGIES AND CHALLENGES

During the early part of the 30 years of the US biotech industry's existence, Australia maintained its history of strong academic research investment especially in areas of national interest. A new direction with a more global outlook and commercial imperative to funding occurred as the potential of patents and innovations were more widely recognised. Government actively encouraged research with industry participation and with a view to engaging investment.

Like the USA, Australian research institutes and universities have yielded innovations that could be taken further through development, with investment, experience and marketing opportunities. These factors however, have remained the primary challenges for Australian biotech companies, and they continue to suffer from (1) the small size of the local market and the distance to key markets, (2) the lack of growth capital and (3) of experienced entrepreneurs/management. To overcome these challenges, Australian companies have used a variety of strategies that included raising money and/or establishing commercial presences in foreign capital markets, partnering early and merging with companies in other countries.

Australian venture investment in

Table 9: Representative companies in inflammation

Company	Product/services	Market cap
Promics	PMX53: C5a receptor antagonist in Phase I	— ^a
C-Bio Ltd	Cpn10: chaperonin 10 in Phase I	22
Pargenex	PAR2 agonist programme for inflammation. Preclinical	— ^a
Cortical	Macrophage migration inhibitory factor (MIF) inhibitor, preclinical	— ^a
Pharmaxis	Bronchitol: Mannitol in a dry powder inhaler in Phase I PXS25 prevent leukocyte migration from blood to surrounding tissues. Preclinical	36

^aPrivate company.

Table 10: Representative companies in neuroscience

Company	Product/services	Market cap
Prana	PBT-1 (Clioquinol) copper/zinc binder in phase II for Alzheimer. PBT-2 follow-up candidate, preclinical	40
Alzhyme	Alzheimer research, preclinical	— ^a
Cogstate	Internet-based psychological tests	9
Bionomics,	ionX™ Portfolio of proprietary gene variations associated with epilepsy	14
QrxPharma	Q8003: novel opioid formulation for pain. Preclinical	— ^a
Xenome	Xen2174 Inhibitor of Norepinephrine Transporter (NET) for chronic pain. Phase I	— ^a

^a Private company.

Table 11: Representative companies in cardiovascular, metabolic disease and virology

Company	Product/services	Market cap
Kinacia	Antithrombotic compound in Phase I	— ^a
Adipogen	Obesity research. Preclinical	— ^a
Biotron	C9/Virion: ion channel modulator for treatment of HIV, preclinical	20
Narhex NSW	NarDG-35 prodrug. HIV protease inhibitor	— ^a

^aPrivate company.

technology has been small, and without significant links to global VC for supporting the continued growth of start-ups. Some Australian companies have compensated for this lack of growth capital by raising money in other capital markets such as the USA. For example, Phenomix raised money from US venture capitalists (Sofinnova Ventures and Alta Partners, in addition to Australian VCs GBS, and CM Capital), and established their business headquarters in the USA, keeping R&D based in Australia. This

also allowed the company to recruit and benefit from experienced US biotech management. Other Australian companies have listed on NASDAQ through American Depositary Receipts (ADRs); an example is Prana, which recently raised US\$20m on NASDAQ ADRs.

One strategy used to better manage burn rate by Australian companies with a heavy reliance on public capital, has been the development of a revenue stream leveraging aligned products and services. For example, CogState has developed, validated and partnered a web-based cognitive assessment tool to measure the progression of central nervous system disorders as a short-term source of revenue, while it is developing novel therapeutics. Another example is Novogen, which has been relying on consumer health products for revenue while developing the anti-cancer drug phenoxodiol.

Another strategy to access foreign capital has been to merge with a foreign company. An example of a transcontinental merger was the very recent combination of Victorian-based AGT with Californian company ChemGenex. AGT had a gene discovery technology and a portfolio of novel genes, but no development products and merged with a company that had a Phase II clinical candidate. Not only did the resulting company have a broader drug discovery pipeline, it could now leverage US financial markets, the US talent pool for management and the lower costs of R&D in Australia. Perth-based Australian Cancer Technology is following the same strategy, with its recent acquisition of US-based Galenica. While the relatively low valuation of some Australian companies could make them an attractive acquisition target for a foreign company, a deal is made difficult by a requirement that 90 per cent of the shareholders of the acquired company tender their shares. Recently the US\$161m proposed acquisition of Sirtex by Cephalon failed because, at the end of the offer period, only 88 per cent of the shares of Sirtex

Table 12: Representative companies with a platform technology

Company	Product/services	Market cap
ES Cell Intl	Stem cell research	— ^a
Stem Cell Sciences	Stem cell research	— ^a
Cerylid	Natural product screening	— ^a
Benitec	RNA interference	63
Mimotopes/Fisher Scientific	Solid phase synthesis. Peptides and small molecules	— ^b
Copyrat	Transgenic rat models	— ^a
Ozgene	Contract service for transgenic animals	— ^a
Phylogica	Screening platform	— ^a
Protagonist	Design of drugs that control protein–protein interactions	— ^a
Eiffel technologies	Supercritical fluids to re-engineer physical properties of drugs	30
AcruX Ltd	Transdermal drug delivery	— ^a

^a Private company.

^b Subsidiary of larger multinational.

Australian companies have tended to partner early with larger foreign based companies

had been tendered, just short of that required by law.

A third strategy for Australian companies has been to partner early (preclinical) with larger foreign-based companies to gain access to sophisticated and expensive development capabilities. While Australia can easily accommodate preclinical and clinical development through Phase IIa proof of concept, the sheer size, diversity and skill set required for a Phase III programme is beyond the country’s reach, if only financially. Taken together with the difficulties brought by low valuations in raising adequate funding to carry out robust clinical development

programmes, companies must partner their assets early.

Table 13 lists some representative examples of alliances. A key early partnership in the Australian biotech industry was the licensing of the influenza drug Relenza to Glaxo from Biota. Another example of foreign partnership has been the licensing of the topical use of PEP005 from Peplin to Allergan, which has provided Peplin with both financial resources and expertise for the development of the anticancer drug. While large drug licensing deals are not common for Australian companies, there are many examples of research collaborations. Merck, for example, has two large research collaborations ongoing with AMRAD for asthma and CSL for papilloma virus vaccine, and Chugai had until recently a research collaboration with AMRAD around haematopoietic cytokines.

Table 13: Representative examples of alliances between Australian biotech and larger pharmaceutical companies

Australian company	Partner	Alliance
Biota	GSK	Licensing of influenza drug Relenza
Peplin	Allergan	Licensing of topical use of PEP005
AMRAD	Merck	Collaboration for the development of new therapies for asthma
Cerylid	Aventis	Natural product screening
CSL	Merck	Co-development of <i>Papilloma</i> virus vaccine
CSL	Astra Zeneca	Co-development of peptic ulcer vaccine
ChemGenex	Merck Sante	Obesity and diabetes gene discovery
Griffith University	Astra	Natural product drug discovery
Prana	Schering AG	New research targets and development of diagnostics for Alzheimer’s disease
QRx	Shire Labs	Development of extended release opioid
Benitec	Merck	Licensing of RNAi technology

CONCLUSION

Australia’s strong academic history and its limited investment capital have combined to make it a country filled with biotech companies with innovative pipelines but limited development capacity and funding. The government is doing its part to encourage partnering and bring about success. For Australian biotech companies, with their sheer numbers, the realities are low private capital accessibility

The industry's future depends on the companies' ability to access worldwide investment, access highly credible scientific and development advice, and engage in the best application of their limited funds

In recent years, some changes that improve the visibility of Australia home started to happen

that necessitates early public exposure, earlier licensing, cautionary patent approaches (owing to the expense) and the resulting smaller pipelines, with survival of the fittest the rule. Australia's biotechnology image will clearly benefit from the survivors able to take advantage of the opportunities afforded by the various strategies discussed and progress their technologies through partnerships and/or overseas funding.

Australia's solid science and appetite for risk will continue to produce novel technologies and products. For the Australian biotechnology industry to be successful, however, some changes need to happen. The industry's future depends on the companies' ability to access worldwide investment, achieve presence where their customers are, access highly credible scientific and development advice, and engage in the best application of their limited funds. Companies need to raise sufficient funds to develop their products to a stage where risk has been significantly reduced and where they can secure better licensing value. At the same time they need to control dilution to maintain shareholder value and management incentives. Companies also need to develop relationships with their customers or partners and keep prospective partners informed as products are progressing through development.

In recent years, some changes have started to happen. There are government incentives to attract foreign venture capital players and select Australian companies have raised funds from overseas private or public markets. Some Australian companies have set up business presence in the USA and have been able to recruit management talent. Initiatives that have promoted the visibility of Australia's biotech industry, such as AusTrade, Invest Australia, the annual AusBiotech conference, the industry's

presence at the annual BIO conference and the new BioAus site at Biospace continue to influence the willingness of the US industry to consider alliances and investment. Also, the recent biotechnology collaboration agreement between certain Australian state governments and the government of New Zealand is aimed at providing a stronger collective identity for Australia and New Zealand in the international biotechnology marketplace. If these trends continue, Australian biotechnology companies will get the opportunity to increase their visibility worldwide and attract the right investment to ensure their success.

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