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First, I would like to improve the effectiveness of our scientific workshops and review the operations of our scientific focus groups. We are also working to increase the number of student chapters and student membership, since students are the future of our association. I am also looking to increase the value of the association to our long-time members – we have responded to our members' needs by adding the annual AAPS National Biotechnology Conference, and it is one of my goals to expand and enhance this meeting. I'm especially focused on communication and publication. Right now, if you really want to get targeted scientific information on an ongoing basis, you have to join a particular scientific society and subscribe to their journal. We have now established several open access electronic journals so you don't have to be a member of AAPS to gain access to them. We also have a comprehensive plan that addresses something we call 'distance learning'. I am very interested in this because we might have an important workshop in the USA, for instance, the one on getting the dosage right, and 300–500 hundred people attend. But what happens to people in Western Europe, India, Egypt or wherever? They are not part of that. If you have a good distance learning program, these workshops can be put on the web and made available immediately across the world. Sharing this information could improve the lives of a lot of people.

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A viewpoint on South Korean Biotech

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Like many other countries in the region, South Korea regards biotechnology as an important area for investment over the next decade. The country has high ambitions for this sector, but its growth depends on an environment that encourages innovation in research and that provides adequate funding of such ventures.

The emphasis on biotech in South Korea is influenced by the outstanding success of the US biotech industry – an economic feat that most other countries would like to emulate. In 1992, revenues from the US biotech industry totaled USD$8 billion, by 2003 this was close to USD$40 billion. There are now 1,473 companies operating in the US biotech industry [1], which illustrates how the conditions for the sector have improved despite the continuing difficulties and expense of drug development. In 2003, the US biotech industry spent USD$17.9 billion on R&D [1], which puts it far ahead of any foreign biotech industry [2]. This commitment to research has made US biotech companies the most successful in terms of new products. Companies such as Genentech, Amgen, Biogen, Chiron and Genzyme have performed impressively over the past 20 years and have brought to market important therapeutic products. An additional benefit for the US sector is that its success attracts those seeking to work in the field. For example, many foreign students, including many from Asia, wish to gain experience working for a US organization.

Matching the success of these US industry leaders is a problem for the young biotech companies in South Korea, as they are operating in a very different environment and at a later stage in the development of the global industry. Funding has always been a problem for biotech companies and investors are much more circumspect about investing in new ventures than they were two decades ago. This is particularly true for South Korea, where the 1997 economic crisis severely dented the country's growth prospects and led to foreign investors selling their assets.

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BOX 1

Major company members of the Korea Bio Venture Association

Company	Speciality	URL	Location
CrystalGenomics	Functional genomics	www.crystalgenomics.com	Seoul
LabFrontier	Customized DNA cloning, protein production and antibody development	bio.labfrontier.com	Seoul
REGEN Biotech	Biomaterials, proteins, peptides	www.regenbiotech.com	Seoul
Aprogen	Humanized monoclonal antibodies	www.aprogen.co.kr	Dae-jeon
Biomedlab	Medical engineering, DNA chips, and other biomedical products.	www.bmelab.co.kr	Ansan
Cell BioTech	Lactic acid bacteria, anti -microbial peptides, and functional food ingredients	www.cbt.co.kr	Gyongki-Do
Chem Tech Research Incorporation	Chirotechnology and antibody research	www.c-tri.com	Kyunggi-do
Green Biotech	Products based on biotechnology, ranging from biopesticides in agriculture to nutraceuticals and foods	www.greenbiotech.com	Kyungki-Do
NeoPharm	Development of bioactive products for use in the medicinal, environmental and cosmetics fields	www.atopalm.co.kr	Daejeon Metropolitan City
Proteogen	Proteomics and provider of platform technology for protein chips and related products.	www.proteogen.co.kr	Seoul

Until 1997, South Korea had prospered. It had regularly posted double-digit growth figures and had been transformed into the world's 11th largest economy [3]. However, economic mismanagement and an accumulation of debts led to a decline in its position.

The South Korean economic situation at present is certainly not as bleak as in 1997, but the recovery has been slow. According to the Economist Intelligence Unit, real GDP growth will drop in 2005 to 3.3% from an estimated 4.8% in 2004, and will recover only modestly in 2006 [4]. This means that although there are positive signs for the emergence of a strong biotech sector in South Korea, they will be affected by how the country as a whole recovers from the difficulties of 1997.

Furthermore, the future of the South Korean biotech industry depends on the people. If those with the appropriate skills are not content with the economic situation in their country they may seek to work abroad. The National Science Foundation has estimated that foreign students account for 40% of US advanced degrees in biology and chemistry [5], and many of these students are from Asia. Given that 60% of foreign students stay in the USA after their degrees to fill senior scientific positions, the potential impact on an emerging sector cannot be ignored [5]. In fact, many countries have successfully attracted back such people, which subsequently stimulated growth of the domestic industry. For example, Taiwanese nationals returning from the USA started Taiwan's Hsinchu Science Park, which features several young biotech companies [6]. In 1986, biotech firms in Hsinchu employed 254 people, a number which has risen to 823 by 2003 [6].

Meeting the challenges

In 2003, the South Korean government held a biotechnology evaluation panel meeting where it announced a total spending of USD$540 million, which is a 19.8% increase in sector spending over that of the previous year [7]. In addition, the government announced plans to invest in infrastructure for a skilled workforce and outlined plans to link biotech R&D with its more traditional heavy industry through specialized projects [7]. Aside from these investment plans, the Ministry of Commerce, Industry and Energy is affiliated with the Korea Bio Venture Association (KOBIOVEN), which is attempting to support the emerging biotech sector. Operating since 2000, KOBIOVEN has attempted to drive growth of the domestic biotech industry by acting as a knowledge forum for its members [8]. It has ten member companies at the core of its organization, whose expertise cover a range of areas such as proteomics, monoclonal antibody research and genomics (Box 1).

Recognizing that it must play a further role in stimulating the environment for its biotech industry, the South Korean government has devised a longer-term plan known as 'the Bio-Star Project'. Launched in 2005 by the Ministry of Commerce, Industry and Energy, this 10 year plan will result in a total of USD$253 million being invested in the domestic biotech industry and will feature cooperation between the South Korean government and business community [9].

The plan is interesting as it does not just focus on funding research projects. The Bio-Star Project will aim to aid those interested in

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TABLE 1

An outline of the South Korean government's bio-industry strategy

Category	Subcategories
Bio materials	Protein products for pharmaceutical and industrial applications
	Molecular pharmaceuticals
	Enzymes for industrial applications
	Bio substances
Applied technology	Medicine delivery systems (sustainable injections, oral formulations, etc.)
	Application-oriented technologies (quality control, quality assurance, scale-up, safety assessment, etc.)
Bio-based hybrid technology	Biochips (DNA chips, protein chips, laboratory-on-a-chip, etc.)
	Bioinformatics (hardware, software, activation technology, etc.)
	Protein and somatology (relational analyses of protein structure/function, etc.)
Bio-therapy	Gene-therapy (gene transmitters of diseases, etc.)
	Cell therapy (cell therapeutics for anti-cancer treatment)

Source: Ministry of Commerce, Industry and Energy

commercializing biotech projects and will provide assistance for the different stages of the R&D process, including clinical development [9]. The government has recognized that much of R&D investment is accounted for by clinical testing and therefore sought to provide funds for specialized contract research organizations in this field [9]. The first applications for funding as part of the Bio-Star Project started arriving in late March 2005 and, following a 45-day reviewing period, successful projects were due to be announced in the summer of 2005 [9].

Emerging sector

According to an analysis by the US Commercial Service, in 2000, South Korea was ranked 14th globally in terms of biotech R&D investment. At this time, Korean government biotech R&D investment was estimated as being 1% of the equivalent in the United States and 10% of Japanese government R&D biotech expenditure [10].

Despite the low level of funding there are promising signs for the South Korean biotech sector. In 1999, there were only 70 biotech start-ups in the country but by 2000 there were 170 and this rose dramatically to 600 by the end of 2002 [10]. These ventures are now seeking investment and partnerships abroad as few of them can remain competitive on their own. Attractions for foreign companies are the strengths of local firms in the areas of fermentation technology, antibiotics, diagnostics, and Hepatitis B vaccine production [10]. Many new ventures are also offering expertise in genomics, humanized monoclonal antibody production. However, most South Korean biotech companies are young and so are limited in the types of technology being used in global biotech research. Therefore many have explored collaborations as a means to gain experience. The South Korean government has identified several areas in which it wishes emerging biotech companies to develop expertise (Table 1).

To promote collaborations with foreign firms, the Ministry of Commerce, Industry and Energy launched a task force consisting of the state-run Korea Trade and Investment Promotion Corporation (KOTRA) and other public and private organizations [11]. The Ministry has also launched additional international exchange programmes to support the domestic biotech sector. These initiatives will focus on the USA, the UK, France, Japan, and China. These programmes do appear to be attracting interest. For example, in 2002, VaxGen, a subsidiary of Genentech, formed a joint venture company with several Korean biotech companies [11].

Another possibility for South Korean biotech collaborations is with the domestic pharmaceutical industry. There are currently around 79 local pharmaceutical companies and they have 86 research laboratories [12]. In 2002, domestic pharmaceutical companies were involved in 90 research projects, with most of these falling into the cancer, anti-infectives, metabolic diseases and immunology categories [12]. The Korea Drug Research Association (KDRA) describes 21 projects as being at various stages of clinical development, with another 47 at the preclinical stage [12]. Despite running these projects, when surveyed 97% of local companies viewed partnerships as being of benefit to their commercial objectives [12].

Conclusion

Biotechnology has been identified by the South Korean government as a key industry for economic growth. Following the economic problems of the late 1990s, the country is keen to implement a practical strategy that will result in a mature industry rather than simply putting forward ambitious proposals. At present the South Korean biotech industry is small, but there is significant potential for growth. The country has set itself the target of accounting for 10% of the world's bio-industry in the future, although no timeline has been indicated. Key to the future of the industry will be the ability of the government to maintain an environment that encourages innovation, but that also provides economic support over the lengthy period of time that is necessary for drug development. Furthermore, it will be required to have in place an education system that encourages students to study scientific subjects and provides them with the training to enter the

feature

industry. Most biotech companies in South Korea are small and relatively immature. If they are to succeed, their best opportunities lie in collaborations with domestic and foreign companies. These will allow them the best mix of economic support and will help reduce the risks involved in drug development.

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feature

Sourcing a chemical succession for cyclosporin from parasites and human pathogens

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David Pritchard is an immunologist and parasitologist conducting research with the express aim of fully understanding several key host-pathogen relationships. He graduated with a PhD in Immunology from the University of Birmingham, and has industrial, university and tropical research experience.

Several clinical centres worldwide are gearing up to trial parasitic infection for the treatment of asthma and Crohn's disease. The present article takes a step forward, and advocates the mining of pathogens from humans, by the pharmaceutical industry, to source novel small molecule drugs for the treatment of immunological disease. It also argues that judicious source selection will lead to the discovery of discriminatory treatments for the phenotypically distinct immunological diseases of humans, with drugs from bacteria to treat autoimmunity (e.g. type 1 diabetes, inflammatory bowel disease, rheumatoid arthritis), and from nematode parasites to treat allergy and asthma.

Diseases with an immunological basis, allergy, type I diabetes, rheumatoid arthritis, inflammatory bowel diseases and psoriasis, affect hundreds of millions worldwide, yet are poorly served by existing therapies, which are often anti-proliferative broad spectrum immune-suppressants, for example azathioprine, mycophenolate mofetil, and the corticosteroids.

Consequently, these therapies fail to exhibit immunological selectivity, given that they suppress the whole immune system, leading to unwanted side effects. They also tend to target the symptoms of disease as opposed to the underlying clinical pathology of the disease cycle.

Target-specific antibody-based therapeutics, and recombinant cytokine receptors offer alternative routes to treatment, but are associated with the disadvantages of being proteinaceous and expensive, and potentially immunogenic. Therefore, a need remains for novel small molecule therapeutics, particularly with immunological selectivity to allow the discriminatory treatment of diseases with an allergic or autoimmune phenotype (see Intelligent Source Selection below).

The HTS approach to drug development could provide an answer, yet is dependent on the accurate identification of disease-related molecular targets. The molecular complexity

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