A maturing industry: Strategic patenting trends, US and academic dominance, and the global biotechnology landscape

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Abstract

Patent analytical data has proved itself a key enabler in measuring the commercial focus and activity taking place within highly research and development (R&D) intensive industries such as biotechnology. Marks & Clerk has assessed biotechnology patent application and grant records from a range of international patent office and proprietary databases, with a view to gauging the industry's commitment to R&D and the particular areas of biotechnology that are attracting investment. Using this research, this paper seeks to provide a snapshot as to the current 'state of play' across the biotechnology sector, looking at strategic trends, technological focus and industry dominance. It also seeks to analyse indicators as to the future commercial development of the industry.

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INTRODUCTION

International patent applications, resulting from the Patent Cooperation Treaty framework (PCT) have witnessed continuous growth since 1978, with 145,300 applications filed in 2006 (accounting for a 6.4 per cent rise on the previous year). The popularity of the international filing route is indicative of an increasingly enmeshed global economy and the emergence of new world players, with Asia steadily recording the highest level of growth in terms of international patent applications.[1]

Yet the trend within the biotechnology industry has been markedly different, with a high level of activity at the start of the decade giving way to a decline in recent years.[2] Merely identifying this trend is insufficient, however, to account for precisely why the international filing route has been shunned, what this means in terms of the industry's commitment to research and development (R&D) as a whole (for which patent levels provide a key indicator here), and what level of patenting activity is taking place and where.

To consider the development of the industry more strategically, the following research concentrates on patent applications and publications spanning the years 2002–2006. This data has then been filtered, firstly by selected key international patent classification (IPC) identifiers and then by the most significant biotechnology players in the industry. This list covers some 250 entities, selected from a number of sources, including

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rankings of the largest biotechnology companies by market capitalisation, biotechnology-related companies listed on a selection of stock exchanges, as well as acknowledging the contribution of some of the fastest-growing specialist biotechnology organisations. The interplay between the academic and corporate sectors necessitates that the data be looked at more broadly to assess the likely overall commercialisation of biotechnology in the future.

HEADLINE PATENTING ACTIVITY

Figure 1 illustrates the number of patent applications published between 2002 and 2006 broken down by geographical territory. As anticipated, a marked decrease is evident in the number of PCT applications (indicated by WO), falling 65.9 per cent, from approximately 2,200 applications in 2002, to less than 750 in 2006. This decline is not matched, however, by the patenting activity at the individual national patent offices, which broadly see a rise of 13.4 per cent in this period. Likewise, the number of patents granted between 2002 and 2006 increased by 17.8 per cent as can be seen in Figure 2.

The increase in the number of patents granted should be attributed in part to better clarity being provided by the respective national patent offices, which is helping to reduce pendency times. This corresponds to programmes such as BEST and the Patent Prosecution Highway, which are currently in place at the European Patent Office (EPO)

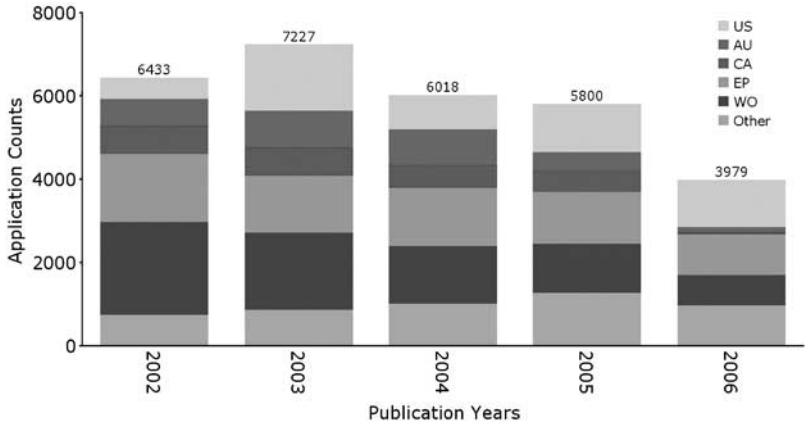

Figure 1: Patent application publications by year
Source: Computer Patent Annuities Limited/Marks & Clerk ©2007

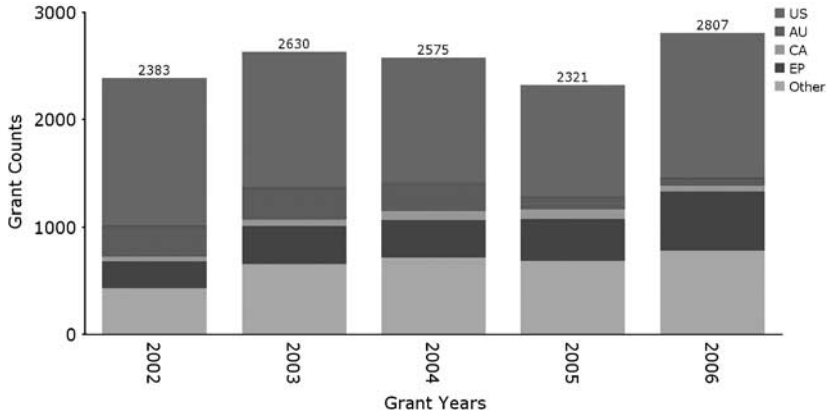

Figure 2: Patent grants by year
Source: Computer Patent Annuities Limited/Marks & Clerk ©2007

and US Patent Office (USPTO). In particular, it is reasonable to assume that a number of recent clarifying decisions by the EPO Boards of Appeal have stimulated a rise in the number of European patents granted. Until pending decisions on biotechnology patentability were resolved (specifically in the areas of second medical use claims, diagnostic methods and gene patents), many European prosecutions faced delays.

In the US, grant figures for 2002 and 2006 are nearly identical, both being in the region of 1,350 patents. Grants in other countries (ie, national patent grants in countries not separately listed) have also increased over the term, from 430 in 2002 to 780 in 2006.

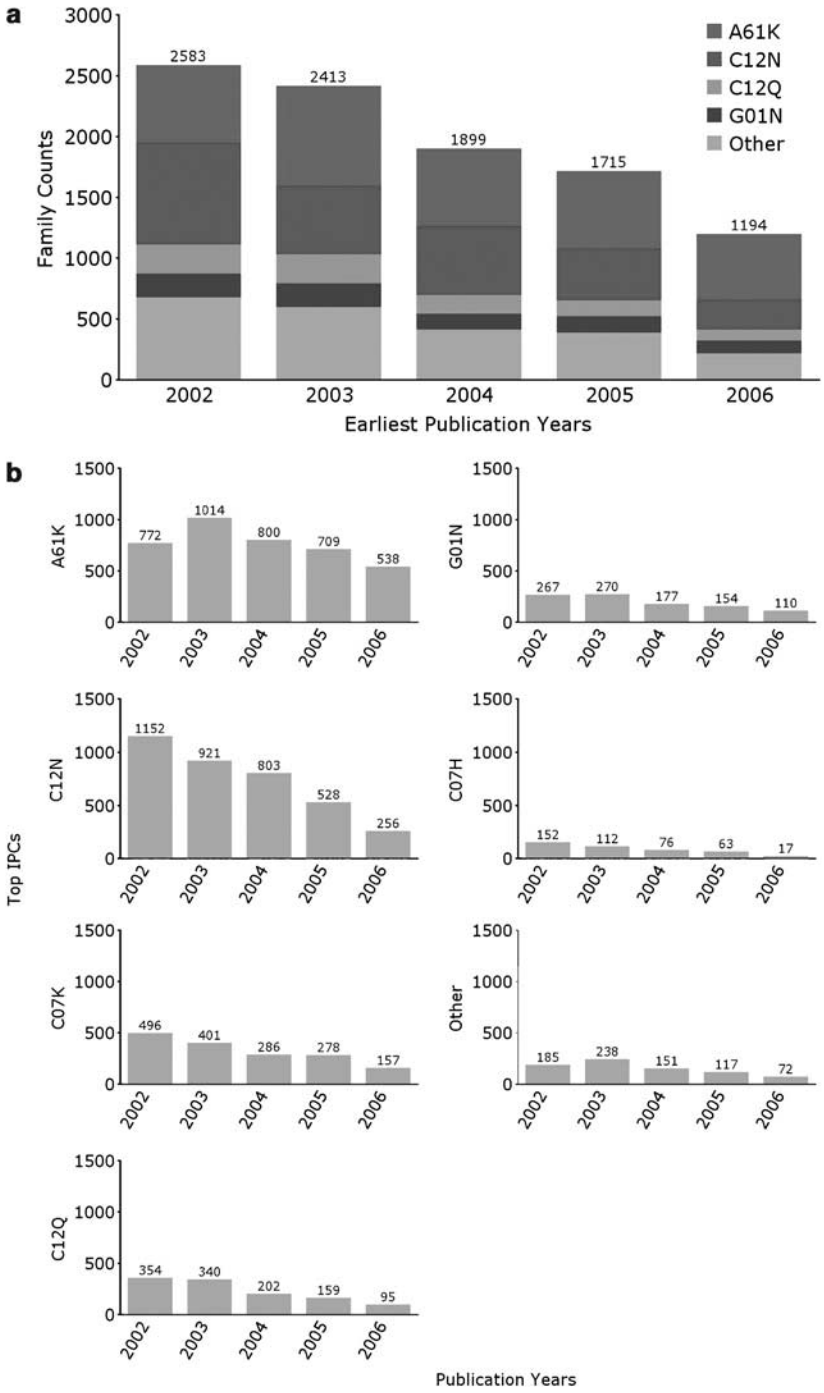

Figure 3: Number of patent families by (a) publication year and (b) IPC
Source: Computer Patent Annuities Limited/Marks & Clerk ©2007

This switch to a more localised filing strategy may, however, also indicate a more important *strategic* shift, when compared with the specific patenting activity taking place. Figure 3 graphically depicts how the overall number of patent families is in fact *decreasing,* from 2,583 patent families in 2002 to 1,194 patent families in 2006. Meanwhile, the number of patents granted at the individual patent offices has increased (as in Figure 2). As the industry matures, it would appear that applicants are filing fewer inventions but are doing so much more widely (resulting in a fewer number of patent families but covering more countries).

This implies that speculative patent applications are being replaced by stronger filings eliciting a greater degree of industry confidence as to their commercial justification (and thus requiring patent protection in many markets). Instead of using the PCT route, applicants are using their experience to make earlier decisions on where to obtain patent protection and tailoring their filing strategies to national laws, rather than applying a 'one size fits all' approach.

KEY AREAS OF BIOTECHNOLOGY DEVELOPMENT

This analysis is supported by a consideration of the individual technologies commanding the attention of the industry, as shown in Figure 4.

This is particularly significant in the context of historical biotechnology patenting activity. Towards the end of the 1990s, substantial patenting activity was taking place relating to sequence inventions, particularly SNPs, ESTs and haplotype mapping. The subsequent introduction of stricter examining guidelines, particularly updated US Patent Office (USPTO) Utility Guidelines,[3] and the adoption of similar approaches by other patent offices, quelled some of the initial flurry of activity around sequence inventions.

In recent years, the shift in technological focus has been dramatic. As recently as 2002, patenting activity was still spread across a variety of patent classes and included a high level of speculative, sequence-based inventions relating to genetic engineering. Yet as Figure 4 shows, this figure falls significantly by 2006, with the focus of research becoming much more concentrated. Almost half (45 per cent) of patent families published in 2006 relate to the A61K class, which constitutes peptides, antigens, antibodies and gene therapy. Applicants are displaying a much more mature approach to their patenting activity, shifting their focus in favour of technologies that are less speculative, closer to market, and more likely to obtain granted patent protection. Particular decreases are marked in the C12N class (relating to genetic engineering), corresponding to the shift away from sequence-based inventions.

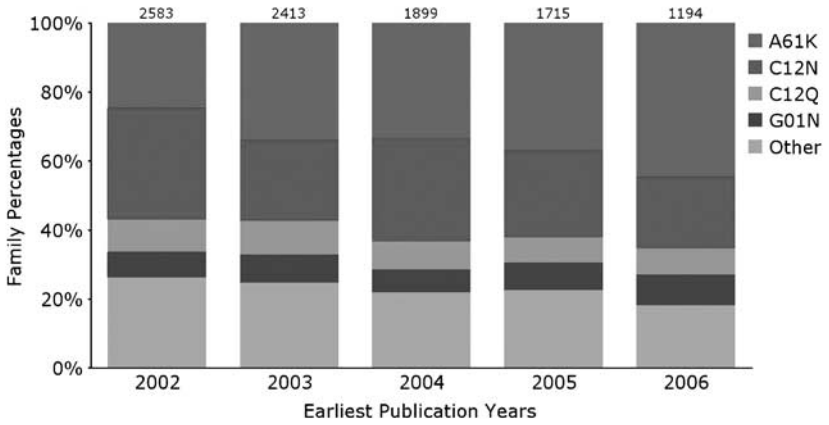

Figure 4: Distribution of patent families by IPC
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PROLIFIC ASSIGNEES: COMMITMENT OF ACADEMIC VERSUS CORPORATE SPHERE

Marked differences are revealed between the academic and corporate biotechnology sectors, when looking at the *volume* of patenting activity taking place. A comparison of the top 20 patent filers, as illustrated in Figures 5 and 6, shows that academic filing outpaced the commercial sector by 51 per cent between 2002 and 2006. At 421 filings, only one corporate (US-based Genentech), would feature in a combined list of the overall top five patent assignees. In short, it is academia and the public sector that is driving the advances in biotechnology research.

The global advantage of the US is clearly underlined here, for while the single most prolific filer in this period was the Japan Science and Technology Agency (with almost double the number of families of its nearest rival, both academic and corporate), it is the US academic sector which dominates. Aside from the Japan Science and Technology Agency, only the University of Tokyo qualifies for a place in the top 20 filers (13th), with about a tenth of the publications of its larger Asian counterpart.

Notably, the impressive performance of the Japan Science and Technology Agency reflects a sustained level of patenting activity on a year-by-year basis. While 2003–2005 were particularly strong years, the high levels of publications have continued into 2006. This is indicative of the substantial investment by Japan into the biotechnology sector and its desire to broaden the technological base of the Japanese economy.

By contrast, Europe's leading academic institutions fail to qualify in this list, despite recent efforts to encourage the growth of spin-out companies and increase patent licensing, and in spite of the EU having the highest per capita number of science and engineering graduates in the world.

As the European Commission has noted, 'this is largely due to a less systematic and professional management of knowledge and

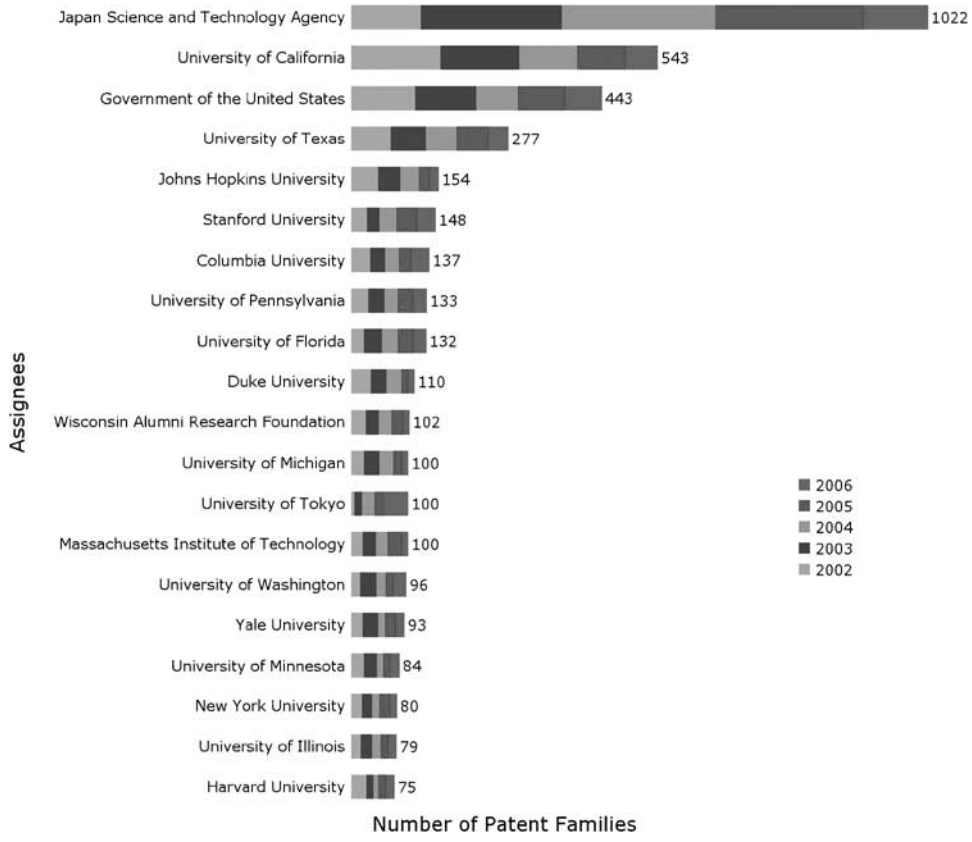

Figure 5: Top academic assignees
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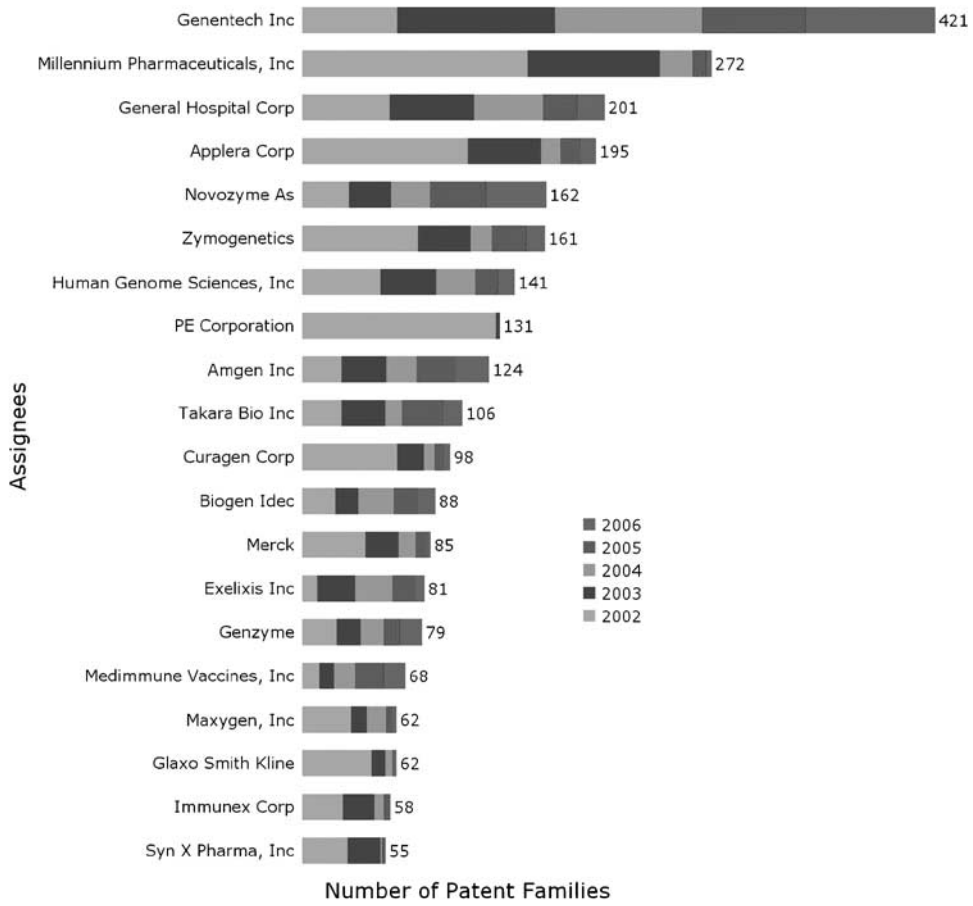

Figure 6: : Top corporate assignees
Source: Computer Patent Annuities Limited/Marks & Clerk ©2007

intellectual property by European Universities'.[4] Addressing this is a priority for Europe, and steps are being taken to try and stem the failure to properly exploit the rich intellectual property resources of Europe.

For the key corporate assignees, the US maintains its pre-eminent position, with Genentech leading the way, closely followed by Millennium Pharmaceuticals. Publications for the remaining top 20 corporate assignees tail off, but not at the same rate as for the academic assignees. Takara Bio Inc. (Japan) in tenth place is the only Japanese corporate listed. Encouragingly, despite the absence of European academic institutions, there is a strong showing of European corporates in the top 20, including Novozymes (Denmark) and GlaxoSmithKline (UK/US).

Figures 5 and 6 also draw attention to the sustained pattern of filing taking place within the academic sector, compared to the short bursts of filing from the corporate sphere. See, for example, the large numbers of filings from 2002 by Millennium Pharmaceuticals, or by PE Corporation and Applera. While it is arguable that this is a by-product of more strategic and focused filing activity (in the pursuit of genuinely more viable drug development), it is nonetheless significant that such a marked gap should exist between the two sectors.

This is particularly important in the context of patent citation. Cited patents give an indication of those patents which are considered to be of relevance to later development, and hence may be treated as an identifier of patents covering fundamental aspects of technologies. Figure 7 illustrates the number of times that each patent has been cited by other, later patents. (Note that the data considers US patents only and that earlier patents will have had more time in which to be cited than later patents.) Figure 7 also indicates the main IPC in which the citation is classified.

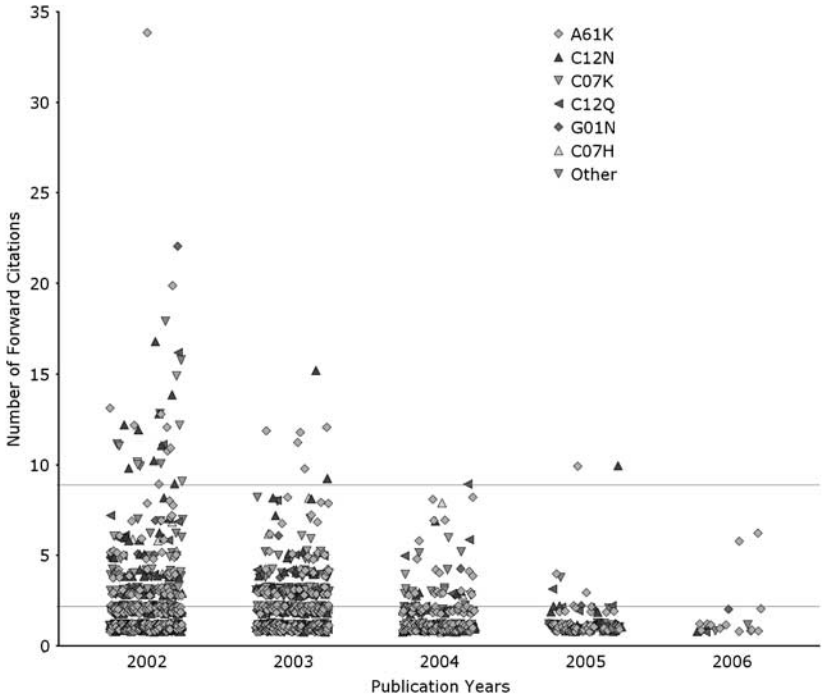

Figure 7: Most frequently cited patents by publication year
Source: Computer Patent Annuities Limited/Marks & Clerk ©2007

The average number of citations per patent is just over two, while the most highly cited patent has been cited 34 times. This patent is US 6,410,516, belonging to Harvard University, Massachusetts Institute of Technology (MIT), and the Whitehead Institute, relating to the nature and role of NF kappa B in regulating gene expression and signal transduction. The fundamental nature of the patent disclosure perhaps explains why the patent is so frequently cited against later filings. The claims of the patent cover various methods of inhibiting gene expression by reducing NF kappa B activity in a cell. The patent also includes many independent claims directed to other consequences of reducing NF kappa B expression.

The second most frequently cited patent (cited 22 times) is US 6,368,877, which discloses self-assembled monolayers of peptides for use as binding targets for cells or ligands and may be used in biological or biochemical assays. This patent also belongs to Harvard and MIT. Overall, of the 12 most frequently cited patents identified in Figure 7, seven are to academic or research institutions, including Yale and Rockefeller Universities and the General Hospital Corporation. The top three are to MIT, either alone or jointly. Thus, it is striking how much of the apparently fundamental research in the biotechnology field is carried out by academic or research organisations.

Of corporate patentees, the highest cited patent is US 6,420,135, to Human Genome Sciences, Inc., covering *Streptococcus pneumoniae* polynucleotides and sequences, while a related patent to antigens and vaccines is also frequently cited. Although Human Genome Sciences does not itself appear to be developing *S. pneumoniae* vaccines, GlaxoSmithKline is developing such vaccines based on technology licensed from Human Genome Sciences as well as MedImmune. A table of the most frequently cited patents is shown in Figure 8.

PROLIFIC ASSIGNEES OF TOMORROW: FASTEST-GROWING PATENTEES

The dominance of the US is further reinforced in a study of the *growth* of patenting activity by geography. Figure 9, based on available data between 1999 and 2004, identifies a number of biotechnology players that are rapidly developing patenting strategies, compared to

Patent Number	Title	Assignee
US6410516	Nuclear factors associated with transcriptional regulation	Harvard University Massachusetts Institute of Technology Whitehead Institute
US6368877	Self-assembling peptide surfaces for cell patterning and interactions	Harvard University: Massachusetts Institute of Technology
US6471993	Three-dimensional polymer matrices	Massachusetts Institute of Technology
US6420135	Streptococcus pneumoniae polynucleotides and sequences	Human Genome Sciences, Inc
US6423514	Mammalian hyaluronan synthases, nucleic acids and uses thereof	Millennium Pharmaceuticals, Inc
US6338953	Expression of an exogenous gene in a mammalian cell by use of a non-mammalian DNA virus having an altered coat protein	General Hospital Corp: Biogen Idec
US6344329	Rolling circle replication reporter systems	Yale University
US6392012	Glycopeptide derivatives and pharmaceutical compositions containing the same	Advanced Medicine, Inc: Theravance, Inc
US6573082	Streptococcus pneumoniae antigens and vaccines	Human Genome Sciences, Inc
US6455311	Fabrication of vascularized tissue	General Hospital Corp
US6355477	Fibronectin and fibrinogen binding protein from group A streptococci	Rockefeller University
US6361974	Exonuclease-mediated nucleic acid reassembly in directed evolution	Diversa Corp: Short, Jay, M

Figure 8: Most frequently cited patents
Source: Computer Patent Annuities Limited/Marks & Clerk ©2007

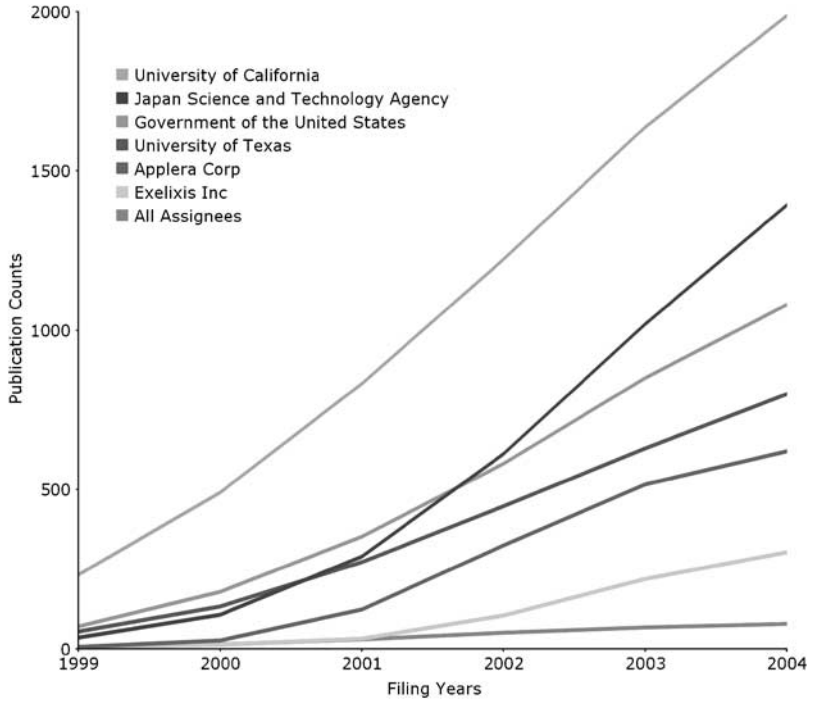

Figure 9: Fastest-growing patent applicants
Source: Computer Patent Annuities Limited/Marks & Clerk ©2007

the near flat growth of the sector as a whole. Viewed against the baseline results or industry average, each of these organisations is implementing strong patent programmes, with publication counts showing intensive growth that far outstrips the competition.

Applicant	Families	Grants	Applications	Ratio applications to families
University of California	543	1491	1581	2.91:1
Japan Science and Technology Agency	1022	103	1647	1.61:1
Government of the United States	443	423	1134	2.56:1
University of Texas	277	369	725	2.62:1
Applera Corp	195	207	505	2.59:1
Exelixis Inc	81	24	346	4.27:1

Figure 10: Fastest-growing patent applicants by ratio: families, grants and published applications
Source: Computer Patent Annuities Limited/Marks & Clerk ©2007

Of the six assignees shown in Figure 9, five are US-based with the most prolific, volume patenting player (the Japan Science and Technology Agency), providing the only global challenge. The second most prolific filer in real terms (the University of California, as indicated in Figure 5) shows the fastest growth.

Comparing the ratio of patent families to published patent applications allows a comparison to be drawn regarding:

(i) an organisation's overarching filing activity;
(ii) the extent of its foreign filing programmes.

For a conventional national patent application, a minimum ratio of 1:1 would be expected. This indicates that each patent application corresponds to a separate family, and that there is only one patent application in each family. A higher ratio generally indicates that patent families cover more than one country.

This comparison underlines key differences among the fastest growing assignees, with the Japan Science and Technology Agency appearing to limit its foreign filing strategy relative to other players such as the University of California and Exelixis. Other companies such as MedImmune Vaccines Inc., Amgen Inc. and Biogen Idec all had patent application to patent family ratios of at least 4:1, with Bavarian Nordic A/S recording an impressive lead at 8.4:1 as outlined in Figure 10.

In view of the strategic patenting trends identified (with organisations becoming much more focused in their patenting activities), Figure 10 helps provide a potentially fundamental indicator of those organisations implementing strong foreign filing programmes, confident of their commercial development. This breadth of filing by applicants also flags the issue of patent case handling. With increasing requirements from patent offices to provide reporting of prior art citations against foreign family members, applicants will have to manage their cases carefully and thoroughly to avoid potentially invalidating their own patents.

PATENT ASSIGNATION: A VIEW ON THE FUTURE OF BIOTECHNOLOGY DEVELOPMENT

Two clear trends have emerged here; one, of a maturing industry taking a more strategic and commercial approach, another of the assuredness of the pre-eminent position of the US, set against strong growth from Asia. Naturally, Asia's growth presents a threat to the continued competitiveness of the US.

In this context, it is worth considering in more detail the origin of the inventors and patent assignees for the various publications considered above. Somewhere between 4,000 and 4,500 publications each year name US-based entities, with a similar number of publications naming US-based inventors. Considering the identified dominance of the US, it is more useful to look at non-US entities here, as Figures 11 and 12 illustrate.

As far as patent assignees are concerned, the largest non-US group is Japanese, with the numbers increasing each year from around 100 publications in 2002 to around 350 in

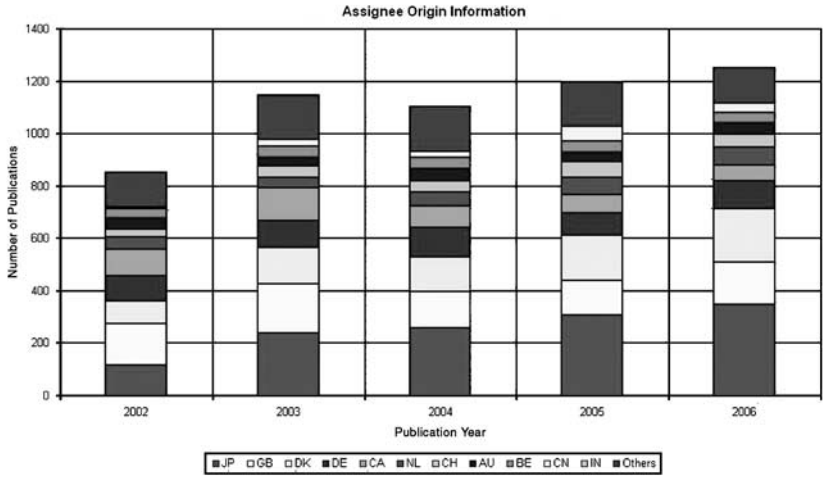

Figure 11: Country of origin of patent assignees
Source: Computer Patent Annuities Limited/Marks & Clerk ©2007

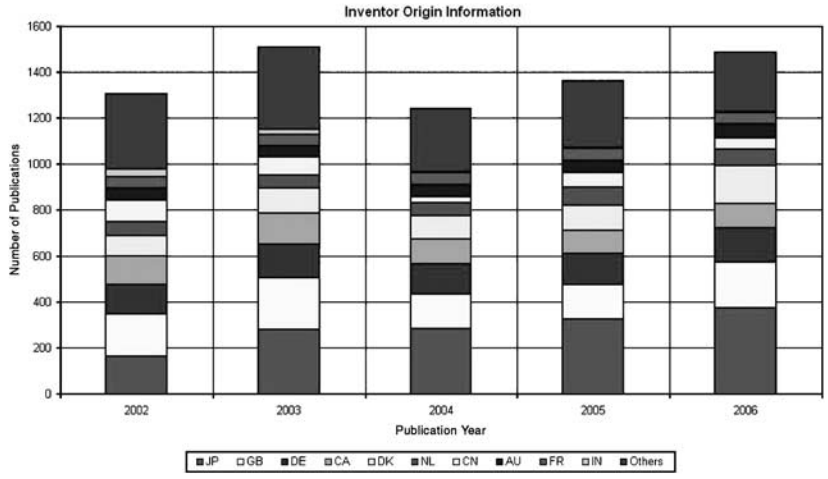

Figure 12: Country of origin of inventor
Source: Computer Patent Annuities Limited/Marks & Clerk ©2007

2006. There is a prominent European presence here as well, with assignees from the UK, Denmark (eg, Novozymes), Germany, Netherlands and Belgium (such as Innogenetics and UCB Group).

The number of publications for each nationality of assignee remains fairly constant year-on-year, with the exception of Japan and also China (with a rise from almost zero in 2002 to around 50 in 2005). Chinese companies covered in this research include Hualan Biological Engineering, Inc., who manufacture a range of blood-related products, and Taihua plc, engaged in manufacture of botanical raw materials for biopharma products. This increase is indicative of the move on the part of Chinese and Japanese organisations to bolster R&D investment in biotechnology.

Notably, the number of applications from Danish companies is also increasing, from around 75 in 2002 to around 225 in 2006. It appears (from this sample at least) that Danish companies are outperforming other European firms in terms of their growth in patent filings. Indeed, in 2006, Danish companies were the third largest filers in the sample, behind the US and Japan.

Turning to the inventor origin information in Figure 12, the data for Japan, UK,

Germany and the Netherlands appears relatively consistent with the corresponding assignee data. This suggests that these organisations tend to employ their own nationals, or that they are unlikely to have significant research bases overseas.

The trends are very different, however, for Canada, Denmark and China. Canadian inventors, for example, are over-represented when compared with Canadian assignees. This is likely to be a result of the pull of the large US-based biotechnology industry, and thus is indicative of the continued international foothold of the US.

Conversely, while Danish assignees are prominent, there are relatively few Danish inventors. The biotechnology industry in Denmark is highly successful but it may be that it has achieved this partly by attracting non-Danish researchers to work in its labs. Alternatively, this data may indicate the presence of research bases outside Denmark – for example, Novozymes has research bases in China, Japan, and the US, as well as in Denmark itself.

The data for Chinese inventors shows a reverse trend; in 2002 and 2003, there were significantly more inventors than assignees, yet from 2004 onwards, the two figures are more in alignment. This implies an emerging, growing strength of the Chinese biotechnology industry, as inventors are tempted away from working for non-Chinese companies to supporting the home-grown industry.

Notably, two nationalities appear in the inventor data but not in the assignee data: France and India. Both of these nations currently punch below their weight as far as the biotechnology industry is concerned when compared with the considerable knowledge and skills bases in each country. It seems fair to predict in the coming years that the rise of India will see this trend reverse, with India building a strong, home-grown industry to compete both with that of China and the rest of the world.

CONCLUSION

These findings suggest that the biotechnology industry is reaching a level of maturity. While the data clearly supports a headline decline in patenting activity, opportunistic research is shifting in favour of more focused filing programmes for key technologies such as antibodies, gene therapy and stem cells – which hopefully signals a clearer commercial return in the future. This view is supported by the industry seeking wider international protection through the respective national patent offices.

This data also highlights the global considerations of the industry's future. This is heavily underlined by the differences between the corporate and academic sectors and the outstanding dominance of US academia, but also in growing biotechnology expertise from Asia and the migration of global talent.

References and Notes

1. Record year for international patent filings with significant growth from Northeast Asia, http://www.wipo.int/pressroom/en/articles/2007/article_0008.html, WIPO, 04 June 2007.
2. See Science and Engineering Indicators 2006, US NSF, Chapter 6, pp. 6–32, http://www.nsf.gov/statistics/seind06/ and USPTO Patent Technology Monitoring Branch, Count of 2001–2005 Utility Patent Grants, By Calendar Year of Grant With Patent Counts Based on Primary Patent Classification, http://www.uspto.gov/web/offices/ac/ido/oeip/taf/tecstc/424_stc.htm.
3. 66 FR 1092, 5th January, 2001, http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2001_register&docid=01-322-filed.
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Appendix

TECHNICAL CLARIFICATION

(A) Classification codes are hierarchical and a single patent will generally be classified by more than one class. A class could therefore be a peptide (C07K) and a medicinal preparation containing a peptide antigen (A61K 39/00).
The search strategy for the research included in this report focused on very narrow classifications, searching specifically for:

1. A61K 48/00 Medicinal preparations containing genetic material which

is inserted into cells of the living body to treat genetic diseases; Gene therapy
2. A61K 39/* Medicinal preparations containing antigens or antibodies
3. A61K 35/* Medicinal preparations containing material or reaction products thereof with undetermined constitution
4. A61K 36/* Medicinal preparations of undetermined constitution containing material from algae, lichens, fungi or plants, or derivatives thereof, eg traditional herbal medicines
5. A61K 38/* Medicinal preparations containing peptides
6. C12N 15/* Mutation or genetic engineering; DNA or RNA concerning genetic engineering, vectors, eg plasmids, or their isolation, preparation or purification; Use of hosts therefore
7. C12P Fermentation or enzyme-using processes to synthesise a desired chemical compound or composition or to separate optical isomers from a racemic mixture

(B) Other codes referred to in the article include:

1. A61K: Preparations for medical, dental, or toilet purposes
2. C12N: Micro-organisms or enzymes; compositions thereof
3. C12Q: Measuring or testing processes involving enzymes or micro-organisms; compositions or test papers therefore; processes of preparing such compositions; condition-responsive control in microbiological or enzymological processes
4. G01N: Investigating or analysing materials by determining their chemical or physical properties
5. C07H: Sugars; derivatives thereof; nucleosides; nucleotides; nucleic acids
6. C07K: Peptides
7. Other=classes not falling into the above .

In order to provide a manageable data set for subsequent analysis, results were then filtered for the following applicants/assignees:

A2 Corporation Limited, Acambis Plc, Acrux Limited, Actelion Ltd, Advanced Ocular Systems Limited, Affymax Inc., Affymetrix, Agenix Limited, Alchemia Limited, Alexion Pharma, Alizyme, Alltracel Pharmaceuticals, Alnylam Pharmaceuticals Inc., Amarin Corp Plc, Ambri Limited, American Oriental Bioengineering Inc., Amgen, Amylin Pharma, Anadis Limited, Angel Biotechnology Holdings, Anges MG Inc., Antisense Therapeutics Limited, Antisoma, Aortech International, Apollo Life Sciences Limited, Applera Corporation, Arena Pharmaceuticals Inc., Ark Therapeutics Group, Array Biopharma, Arthro Kinetics, Asterand, AtheroGenics, Australian Natl University, Avacta Group Plc, Avantogen Limited, Avastra Ltd, Avexa Limited, AVT Plasma Limited, Axis-Shield, Basilea Pharmaceutica AG, Bavarian Nordic A/S, BB Biotech AG, BBI Holdings, Benitec Limited, Biodiem Limited, Biofusion, Biogen Idec Inc., Biolayer Corporation Limited, Biomarin Pharmaceutical, Bionomics Limited, Biopharmica Limited, Bioprospect Limited, Biosignal Limited, Biosite, Biota Holdings Limited, Biotech Capital Limited, Biotechnology Biological Sciences, Research Council (BBSRC), Biotron Limited, Biovitrum AB, Bone Medical Limited, British Columbia University, BTG, California – Berkeley University, California – Los Angeles University, California – San Diego University, California – San Francisco University, California Inst Tech, Cambridge University, Cardiome, Carnegie Mellon University, Cedars Sinai Medical Center, Celera Group Applera Corp., Celgene, Cellestis Limited, Cenes Pharmaceuticals, Cephalon, Cepheid, Cerus, Chicago University, Circadian Technologies Limited, CK Life Sciences Int'l Inc., Cogent Inc., Cold Spring Harbor Laboratory (CSHL), Columbia University, Cornell University, Crucell N.V., CSL Limited, Cubist Pharma, Curagen, Curidium Medica Plc, Curis, CV Therapeutics, Cytos Biotechnology, CytRx, Cytyc Corporation, Dendreon, Discovery Labs, Diversa, Duke University, Dundee University, Dyax, Edinburgh University, EiRx Therapeutics Plc, Elan Corporation Plc, Entelos Inc., Enzo Biochem, Evolutec Group, Exelixis Inc.,

Florida University, Galapagos Nv, GeneMedix, Genentech Inc., General Hospital Corporation, Genesis R&D Limited, Genmab A/S, Genomic Health, Gen-Probe, Gentronix, Genus Plc, Genzyme Corporation, Geron Gilead Sciences Inc., GTx Inc., Harvard University, Hualan Biological Engineering Inc., Human Genome Sciences, Icagen, Icos, Idenix, Illinois – Urbana Champaign University, Illumina Inc., ImClone Systems, Immupharma, Imperial College London, Incyte Corporation, Innogenetics NV, Innovata, Intercytex Group, Intermune Pharma, Invitrogen, Isis Pharma, Japan Science And Technology Agency, Johns Hopkins University, Karolinska Inst Stockholm, Keryx Biopharma, Kyoto University, Leiden University, LG Life Sciences Ltd, Ligand Pharma, Manchester University, MannKind Corporation, Maryland – College Park University, Massachusetts Inst Tech (MIT), Max-Planck, Maxygen Inc., Medarex Inc., MedImmune, Merck Serono S.A., Mesoblast Limited, Michigan – Ann Arbor University, Micromet, Millennium Pharmaceuticals Inc., Minnesota – Twin Cities University, Momenta Pharmaceuticals Inc., Morphosys AG, Munich University, Myriad Genetics Inc., Nabi Biopharmaceuticals, Nanogen, Natraceutical S. A., Neurochem, Neurosearch A/S, New York University, NextGen Group, Northwestern University, Norwood Immunology, Novozymes A/S, Nuvelo, Ondine Biopharma Corp, Onyx Pharma, Osi Pharma, Osiris Therapeutics Inc., Oxford University, Pacific Edge Biotechnology Limited, Pain Therapeutics, Paris 06 University, Pasteur Institute, PDL Biopharma Inc., Pennsylvania State University, University Park, Peptech Ltd, Pharmion, Phynova Group, Phytopharm Plc, Pittsburgh – Pittsburgh University, Pozen, Princeton University, Progenics Pharmaceuticals Inc., Protein Design Labs, Protherics, Proximagen Neuroscience, QLT, Regen Therapeutics, Regeneron Pharma, ReNeuron Group, Renovo Group Plc, Rockefeller University, Rutgers State University – New, Brunswick, Savient Pharmaceuticals Inc., Sequenom, Southern California University, SR Pharma, Stanford University, Stem Cell Sciences, SurModics Inc., Swiss Fed Inst Tech – Zurich, Symyx Tech, Taihua Plc, Takara Bio Inc., Tanox, Tech University Munich, Techne Corporation, Tepnel Life Sciences, Texas – Austin University, Texas Southwestern Med Center University, The Medicines Company, Theratase, Theravance, Tokyo University, Toronto University, UCB Group, United States Government, University College London, Utrecht University, ValiRx Plc, Vanderbilt University, Vernalis, Verona Pharma Plc, Vertex Pharma, Washington – Seattle University, Washington University – St Louis, Wellcome, Wisconsin – Madison University, XTL Biopharmaceuticals, Yale University, YM Biosciences Inc., ZymoGenetics Inc.