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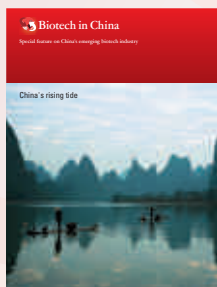
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FEATURE

B2 CHINA'S PHARMACEUTICAL SECTOR: THE THIRD PILLAR

Biopharma dealmakers is providing an update on the rapidly expanding healthcare and pharmaceutical sector in China. CROs willing to share in the risk of development and a growing interest in neuropharmaceuticals are among the emerging trends.

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China's pharmaceutical sector: the third pillar

The pace of change in China's healthcare and pharmaceutical sector is swift. Among the changes are local operations stepping up their international roles and a growing interest in neuropharmaceuticals.

In June, Health Minister Chen Zhu boasted that China had, during a short 2-year initiative, put 95% of the country's population on health care and created the world's largest medical insurance system. Since 2009, the government has invested ¥850 billion (US\$134 billion) to implement the health reform program. That investment, and the extended coverage, is proving a boon for the pharmaceutical industry.

According to an IMS Health forecast, China's pharmaceutical market will grow to US\$50 billion in 2011. Now with the world's third-largest pharmaceutical market, its 2011 growth rate is predicted to be a sprinting 27%. Other forecasts confirm speedy expansion. This March, the National Development and Reform Commission released data showing that the output value of China's medical instruments and pharmaceutical industries will jump 24% to ¥1.55 trillion (US\$2.4 billion) in 2011. Chinese and multinational corporations (MNCs), previously focused on the prosperous coastal markets, are pushing into second- and third-tier inland cities and ramping up production to meet the demand. Most expect China's market to rank second within the next five years.

With its massive population increasingly aware of, and desirous of, cutting-edge medicines, the government has goals beyond a large national market. The government wants to make sure that the drugs being distributed are the most effective available. And it wants domestic companies to play a part in producing them. To this end, the government is putting forward new funding initiatives and regulatory policies that favor innovative drugs over generics. This is an open door for creativity.

The dynamics of the pharmaceutical industry are changing too. Five years ago, MNCs mostly directed research from overseas using contract research organizations (CROs) in China. But CROs have proven themselves, and now, along with a growing number of biotechnology companies, they are moving into more challenging and lucrative fields of discovery, increasingly sharing risk with bigger players.

MNCs are finding that conducting research in China is more than just a good way to get into the market. With the growing number of talented researchers and quality CROs, China is becoming one of the best places to carry out drug discovery and product development. Indeed, outside of the US and Europe, China is now the place of choice to establish research and development operations that are fully integrated into and supporting an international pipeline. "They are taking charge. They have a sense of ownership," says Novo Nordisk executive vice president and CSO Mads Krosgaard Thomsen of the company's R&D China unit. "China is place to be there in the future."

Multinational companies: here to stay

At first, many skeptics thought that R&D investment in China was merely a way for MNCs to adapt products and expand the Chinese market while doing little actual research. This might once have been true, but times have changed. Now MNCs are making Chinese R&D operations part and parcel of an international strategy. As Jingwu Zang, head of GlaxoSmithKline (GSK) R&D China, says: "We're building a global pipeline."

For some, the increased investment is an attempt to create new drugs for Chinese or Asian populations. With over US\$100 million invested in China, AstraZeneca has established: Innovation Center China in Shanghai which opened in 2007 and currently has a staff of 80, and a new China Clinical Operational Hub, also located in Shanghai, which opened in February this year. "We believe now is the time to further accelerate our R&D efforts in Asia, including China," says Steve Yang, AstraZeneca's vice president and head of R&D for Asia and emerging markets. "Asian and Chinese scientists will help us turbocharge our discovery efforts—in Asia and beyond," adds Yang. "We want to be at the vanguard of innovation to meet patient needs."

The Innovation Center China focuses on finding specific biomarkers and genes related to diseases that are more prevalent in China and the rest of Asia, such as gastric and liver cancer. "At its simplest, we are aiming to answer the question, 'Why, on occasion and seemingly inexplicably, are there diseases and conditions that are more prevalent in Asians?'" says Yang. That philosophy powered 44 clinical studies with over 9,000 subjects at approximately 330 sites across China in 2010.

Bayer HealthCare, which in 2009 laid out a budget of €100 million (US\$136 million) over the next 5 years to build a global R&D center in Beijing, is likewise aligning R&D with regional needs. Asian patients will be involved early in drug development in an attempt to "break the tradition of US and EU first" according to a Bayer press release. The strategic focus will be on cardiology, stroke, diabetes, oncology, diagnostic imaging and women's health care. "The mission of our global R&D center in Beijing is to build a strong product pipeline and portfolio against diseases that affect a large number of patients in China as well as in other Asian countries," says Yuhang Zhao, head of global development Asia Pacific at Bayer HealthCare in Beijing.

But Bayer is also integrating work in China with global R&D operations, and the Beijing unit will complement its German and US R&D centers. "Our key focus is on talent: who we can develop into high-quality clinical development leaders for our global development organization and who can lead global teams that include US



Jingwu Zang, head of GlaxoSmithKline R&D. GSK has made their China R&D part of their international strategy.

and EU clinical development staff," adds Zhao.

Indeed, many MNCs are increasingly integrating Chinese operations into global R&D networks and using them to make drugs for the global market. Along with the US and Europe, China is becoming a third pillar for drug discovery pipelines for companies. Roche, for example, slashed personnel in the US and Europe last year and then announced that it would boost staff in China by 25%. This year the company made a US\$75 million expansion of its Zhangjiang facility, which it designated its third global strategic hub, after Basel, Switzerland, and San Francisco.

The integration of Novo Nordisk's Chinese unit happened slowly and systematically—from 15 people in China in 1997 to 100 now at its Beijing-based Research and Development Center China. On September 13, 2010, the company announced plans to double that number, with US\$100 million in investment capital, over the next 3 years. "We took a baby-step approach. We wanted our R&D center in Beijing to prove itself in a way that didn't put our IP at risk. We're expanding in a controlled fashion, not by brute force. This allows people to think out of the box," says Thomsen.

Initially, China was just for services such as making growth hormones in bacteria, but it soon expanded to more challenging tasks such as generating humanized mouse antibodies. "To be honest, it's become a center of excellence within Novo Nordisk. If some group wants an assay antibody, they are the guys that we'll go to," says Thomsen. "They started doing immunotechnology and now are doing even more creative work, like managing a research project throughout the value chain. It's one portfolio across continents."

Other companies are beefing up their Chinese staff as they go. Merck's strategic focus has "changed from 'in China for China' to 'in China

for China and in China for global' due to available talent, the many fine academic institutes for collaboration, qualified vendors to provide service and an improved clinical development infrastructure," says Ruiping Dong, senior vice president and head of Merck's Emerging Markets R&D. Eli Lilly has been investing over US\$50 million annually in China as it integrates its Chinese unit into global operations that themselves are undergoing a transformation from a "fully integrated pharmaceutical company" to a "fully integrated pharmaceutical network," described Tony Zhang, Eli Lilly's vice president of global external R&D for Asia. Last year, Pfizer opened a global R&D center for radiation biology and drug development in Wuhan. The facility, which will complement its larger R&D operation in Shanghai, plans to increase staff from 40 to 200 by next year. And in October 2010, Xian-Janssen, the Chinese arm of Johnson & Johnson, announced plans to intensify research on cancer, tuberculosis, hepatitis C virus, and cerebrovascular and urological diseases over the next decade with an ambitious target of putting over 20 new products into the pipeline.

Sharing risk

This change in dynamic, with research in China playing more of an equal part in the global strategy, has been enabled by increased risk sharing and collaborations between large pharmaceutical companies and CROs, biotech companies and research institutes.

Eli Lilly has been a leader in the use of risk-sharing models with a number of CRO and biotech partners, including ChemExplorer, Hutchison MediPharma and WuXi AppTec, according to Zhang, "Local CROs have proven responsive to customers' needs by making the necessary investment in infrastructure as well as recruiting experienced scientists to work on Lilly projects," says Zhang. Lilly plans to expand the scope of R&D collaborations from mid-stage to early stage and from small molecules to biotech.

There are gaps in the "target-to-drug" system in China that the CROs help to fill, explains GSK's Zang. "You see a lot of science but not much translation. This disconnect cannot be solved by money. But many small biotech companies are joining the CROs to fill gaps in an integrated system," says Zang.

One Chinese company to benefit from the risk-sharing model has been Hutchison MediPharma, which has been conducting research collaborations with Eli Lilly, Johnson & Johnson and Merck Serono since 2007. "At the time, each collaboration was the first of its kind in China," says Samantha Du, founding CEO of the company.

Now with over 200 employees, the company has built a platform for discovery and development in cancer and autoimmune disease, and it is adding clinical and translational research capabilities. "Over the long term the company intends to become an R&D-based, fully integrated pharmaceutical company, leveraging our unique competitive advantages in China," says Du. The company now has six clinical programs—all based on in-house discoveries—including its

leading candidate, HMPL-004, an oral botanical product that acts on multiple targets in the pathogenesis of inflammatory bowel disease. HMPL-004's clinical success in a 223-patient global trial has won it various innovation awards.



Ruiping Dong, senior vice president and head of Merck's Emerging Markets R&D commented on the division's change in focus from 'China for China' to 'China for Global'

Ownership and vision: China's edge in neuropharmaceuticals

With the comprehensive R&D support system taking shape, MNCs are entrusting large segments of their pipelines to Chinese units. The most notable example is GSK. In 2010, the company designated their Shanghai center as the global hub of neurodegeneration and neuroinflammation research, and coordinated it to work with a late-stage development group based in North Carolina's Research Triangle Park to deliver the pipeline.

The strategy worked. The Zhangjiang-based neurology unit now has 310 employees, about 45% of which are returnees with extensive experience in academia, biotech or with a major pharmaceutical company in the west. GSK plans to build a new facility in Zhangjiang. In 2010 and 2011, the China unit started four clinical trials in Alzheimer's disease (AD) and multiple sclerosis. All clinical and preclinical compounds under current development are potentially first in class, according to Zang. "That's rare. Most people work on similar targets. Our focus on innovation has paid off."

In multiple sclerosis studies, for example, instead of looking at targets similar to β -interferons, copaxone or Tysabri (all of which target inflammation), GSK is taking on myelin repair. "Otherwise, even if you stop inflammation, myelin damage continues," says Zang. GSK China has already racked up a handful of papers on IL-7 and leukemia inhibitory factor, and the role each plays in selective immunomodulation and myelin repair. Clinical trials are planned.

Zang's strategy will be to squeeze more information out of phase 1 and phase clinical trials, which normally focus on safety, by measuring "mechanistic signals"—changes in biomarkers and imaging that might indicate whether a drug is having an effect. "The compound might

not decrease amyloid, but it could be having an effect," says Zang. That information will help GSK decide which drugs to move to phase 3 and whether they might need to be used in combination. "That will help us reduce phase 3 attrition," says Zang. In AD, too, instead of focusing on β -amyloid, which has conventionally been thought to cause the disease, GSK will look at multiple pathways. "It's hard to imagine a single-pathway approach would work effectively in such a complex pathology" says Zang.

The China move allowed this type of focus. "With ownership of the whole therapeutic area, we have the opportunity to build vision and strategy," says Zang.

GSK is not alone in looking to China for neuroscience research. Eli Lilly is poised to take advantage of recent advances in biomarkers, imaging and genetics to help it push forward the 14 molecules in its pipeline that are being evaluated to treat neurological diseases and disorders, such as schizophrenia, attention deficit disorders, depression, pain and migraine. "Neurological disease is one of the top three disease areas in China, and the market is growing rapidly," says Lilly's Zhang. "China's aging population, mounting stress level from modernization, economic progress and growing public awareness of neurological diseases indicate a positive future for the neurological pharmaceutical market in China."

Greg Scott, founder of the Shanghai-based consulting firm ChinaBio, agrees that neurodegeneration and neuropsychiatric drugs have a promising future in China. "This is a newer therapeutic area for China, as they first recognized CNS-related conditions as diseases only about seven to eight years ago," says Scott. Scott's 2010 data shows that CNS drug studies account for the fourth-largest number of clinical trials and the third-largest number of preclinical trials in China.

Domestic companies also recognize the opportunity. Yangtze River Pharmaceutical Group, based in Yangtze, has some ten products under development for treatment of neurological, neuropsychiatric or neurodegenerative diseases. AD and Parkinson's disease medicines are currently a small fraction of sales, says Yangtze president Jingren Xu. "But with the aging population greatly increasing in China, they will become primary diseases for the elderly and sales for drugs will significantly increase," Xu adds.

Shenzhen-based Chipscreen Biosciences is generating compounds targeting two pathways that may potentially be useful for neurological and neurodegenerative treatments. "This is an emerging market opportunity where the awareness for neuropsychiatric and neurodegenerative diseases are clearly increasing. The sales for certain multiple sclerosis treatments, including drug and nutraceuticals, are booming in China," says Chipscreen CEO Xian-Ping Lu.

The Guangzhou Institute of Biomedicine and Health (GIBH) sees a huge opportunity in AD treatments. Compound GIBH-001, designed to block neuroinflammation, represents a new class of compounds and has demonstrated significant efficacy in several *in vivo* models of AD,



Jingren Xu is president of Yangtze Pharmaceutical, a company with ten products under development for neurological diseases.

stroke and rheumatoid arthritis. GIBH plans to file an Investigational New Drug (IND) application in 2012. "In 2008, it was estimated that more than US\$50 billion was spent by China on health-care expenses and lost wages for AD patients and their caregivers," says chief technology officer Micky Tortorella. Estimates predict that more than US\$300 billion will be spent annually by 2050. "Unfortunately, there are no disease-modifying drugs available, and current therapies only treat the symptoms of the disease. With the largest aging population in the world, China has an opportunity and duty to fund as well as lead AD research and drug development."

In the future, China is sure to claim a large share of the research pie in other fields, such as diabetes, which has spread quickly with the expanding middle class. In November 2010, Lilly announced its plans to open a diabetes research center in Shanghai. The Lilly China Research and Development, headed by Bei Betty Zhang, will employ over 100 scientists and support staff, the majority of whom will be hired from within China. The center is expected to open by the beginning of 2012. Novo Nordisk will also be addressing diabetes in the country. "In the first few years, it won't be able to [develop diabetes drugs] from A to Z, but it will contribute," says Thomsen. "Eventually it will be a superpower in diabetes research."

Finding new leads

The ability of China-based pharmaceutical companies to achieve 'discovered in China' blockbusters could be assisted by better leads from universities and research institutes. But technology transfer has far to go. China does not have a law like the Bayh-Dole Act, which allows universities in the US to take control of intellectual property emanating from research performed in the country, and so it is not always clear who has control of the intellectual property. "Most universities and institutes are still very new to this, complicating the negotiations," says ChinaBio's Scott. But Scott says some are becoming "reasonably sophisticated in their deal making."

Tsinghua University is one of the most active. "In the school of life sciences alone, there has been activity on three fronts, says dean Yigong Shi. In 2009, a major technology transfer

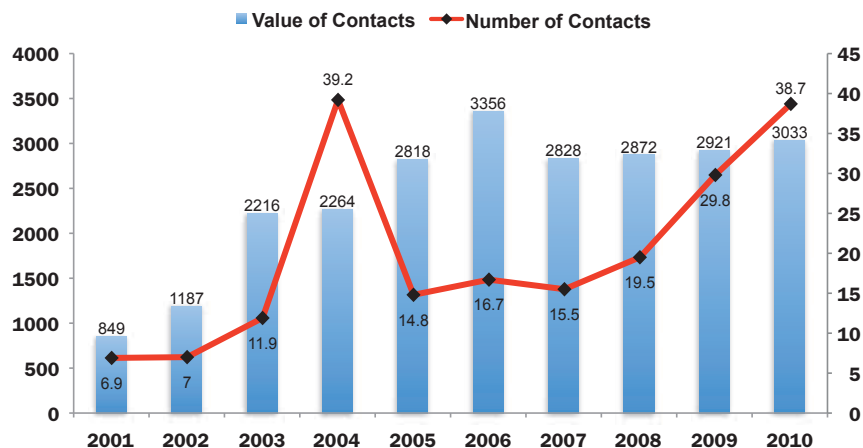


Table 1. Quantity and turnover of pharmaceutical technology contracts output in Beijing (2001-2010). [unit: ¥100 million]

agreement allowed Shandong-based Lu Kang Pharma to produce biomaterials from bacteria. In 2009, Guoqiang Chen of Tsinghua's School of Life Sciences signed a major tech transfer agreement with a Shangdong-based Lu Kang Pharma to produce biomaterials from bacteria. Yongzhang Luo of the university's School of Life Sciences, who managed to get an endostatin variant, Endostar, into the clinic to treat cancer patients, is also finding partners. And Qingyu Wu, Qingyu Wu also of Tsinghua's School of Life Sciences has penned an agreement with a company in southern China to produce biofuel.

Tsinghua is also getting a boost to its technology transfer activities from MNCs. In March 2009, Bayer HealthCare and Tsinghua University established the Research Center of Innovative Drug Discovery with Yigong Shi as director. The center focuses on Bayer's core areas of oncology, diabetes, women's health, diagnostic imaging and cardiology. "We have been very active in forming research collaborations with Chinese academic institutions," Jennifer Hu, head of Bayer's Global Drug Discovery Innovation Center China in Beijing. Similarly, this year, Xian-Janssen Pharmaceutical and Tsinghua University launched the Infectious Diseases Joint Research Centre which aims to accelerate the development and commercialization of tuberculosis and AIDS drugs.

The GIBH also sees the future in collaborations with industry. The real challenge in doing so, says Tortorella, is for universities and research institutes to develop the necessary infrastructure for advancing more mature drug candidates. "That will dramatically increase the value of the IP and attract more interest," says Tortorella. GIBH is assembling a clinical team that will coordinate both phase 1 and 2 clinical trials in China. To that end, GIBH is planning the creation of a new medical center in Guangzhou. IND status for two internal clinical candidates is expected in 2012. To stimulate biotech, GIBH has already spun-off a company named GZstem. With an operational budget of around US\$2 million per year, GZstem derives induced pluripotent stem (iPS) cells from the tissue of normal and diseased

human specimens and devises new protocols for directed differentiation of iPS cells into different cell lineages.

GIBH already has partnerships with Sigma Aldrich and GSK, and it is hungry for more. "These collaborations allow us to share the risk and expense associated with drug development," says Tortorella. "In the future most of our internal programs will be in partnership with pharmaceutical and biotech companies."

MNCs are happy to have the opportunities to work with research institutes and universities. Novo Nordisk is funding a prediabetes research project with the Shanghai Institute of Biological Sciences, and it donated a half million chemical compounds to the institute to do screens for neglected diseases. Merck has signed a deal with BGI, formerly the Beijing Genomics Institute, to focus on the discovery and development of biomarkers and genomic technologies. "This will help to create value from the massive output of genomic information enabled by DNA sequencing and analysis," says Merck's Dong. He adds, "The ability to tap talent and capabilities and engage in academic collaborations with leading universities and healthcare institutions is another advantage [of being in China]." In 2009, Pfizer signed a ¥3 million (US\$470,000) partnership with Peking University's Health Science Center to develop pharmacometrics, a discipline which applies mathematical techniques to drug development. GSK is also reaching out to Chinese academia, with collaborations with the Chinese Academy of Sciences and a number of top universities in the past three years. "China is increasingly competitive for innovation," says Zang. "It's not cost that brings us here."

Lilly was so confident that Chinese academics and biotechs would turn up bright ideas that it established a venture capital team in Shanghai in 2007. So far it has made 7 investments in China worth a total of over ¥300 million (US\$47 million).

Indeed, investment is streaming into China. According to ChinaBio, venture capital investment in the Chinese biomedical industry climbed 319% in 2010 to over US\$1 billion, with the average investment nearly doubling to US\$21 million.

And 2010 also saw the first venture capital investment over US\$100 million—for AutekBio, a Beijing-based biologics contract manufacturing organization in Beijing.

“The upshot of all this activity,” says Ning Ning, Assistant to Director-General, Manager, Technology Transfer Team of the Beijing Pharma and Biotech Center, “is a dramatic increase in deals for transferring biopharmaceutical technology.” In 2010, Beijing had 3,033 pharmaceutical technology contracts—nearly a quadrupling of the 849 contracts signed in 2001—and a turnover of ¥3.87 billion (US\$ 6.4 million), an increase of 29.7% over 2009. The 2010 leader in contract deals was Shanghai (¥8.34 billion, US\$ 1.31 billion), followed by Jiangsu (¥4.12 billion, US\$6.6 million), Beijing, Guangdong (¥1.33 billion, US\$2.1 million) and Shandong (¥1.25 billion, US\$2 million, see Table 1).

This overall uptick was largely a result of the huge increase in the average transaction price. After a short dip in the middle of the decade, in 2010 the average biopharmaceutical technology development contract in Beijing grew to ¥2.6 million (US\$410,000), and the average technology transfer contract grew to ¥1.9 million (US\$300,000, see Table 2). Notably, although Chinese-invested companies accounted for 76% of the transferred technology, those contracts only accounted for 37.3% of the total value, meaning the value of contracts to a foreign investor was considerably higher.

Building bridges to the US

Although MNCs are looking to China for innovation, some Chinese pharmaceutical companies are looking in the opposite direction.

David Jiang, who advises companies on US-China deals at San Diego-based BIOCOM China Consulting, says that over the several past months, he has been forced to turn down business. As Chinese companies try to move beyond generics and provide best-in-class drugs for the growing middle class, “there’s been an opening of the floodgates,” says Jiang. “Many Chinese companies are product poor and cash rich. In the US, it’s the opposite: they’re product rich and cash poor.”

Yangtze, for example, with its 8,000 employees and annual sales approaching US\$4 billion, was generally known as a generics producer, but it is hungry to move up the food chain. From 2006 to 2010, the company invested more than US\$500 million in R&D, including a US\$33 million ‘innovative research center’ in Taizhou. From 2010 to 2015, the annual R&D budget is projected to be over US\$200 million (¥1.3 billion). The company now has some 100 compounds in preclinical studies and more than 20 compounds in clinical trials, the leads mainly coming from internal R&D or Chinese research institutes, universities and biotech companies.

The company is now ready to move into biologics, and last year it opened a San Francisco subsidiary, Pan-Pacific Biopharma, to assist. “This is a new direction for Yangtze,” says Senping Cheng, who heads Pan-Pacific Biopharma. The US unit is charged with recruiting expertise in drug discovery and development, discovering promising

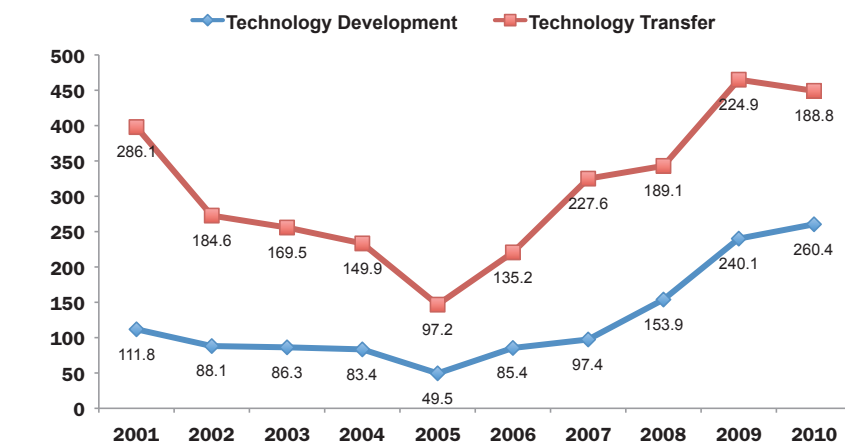


Table 2. Trend of average transaction price of single pharmaceutical technology contracts in Beijing (2001-2010).

leads in the US, and seeking partnerships with US pharmaceutical companies, biotechs and universities. Yangtze also plans to build a research institute in the US and register two traditional Chinese medicines and other drugs in the US. “In terms of innovation, our overall strategy is to combine the advantages in these two countries to effectively shorten product development time and lower cost,” says Cheng.

Yangtze not the only Chinese company looking abroad. “WuXi and Beijing Pharma are consistently in San Diego looking for partners, and the major life science parks in Beijing, Shanghai and Suzhou are looking to us for companies interested in establishing operations there,” says Joseph Panetta, president of BIOCOM.

BIOCOM started an Asia initiative to connect members with Chinese life science partners four years ago, but partnerships are still rare in the early stages. “There is a continuing concern on the US side about intellectual property protection. There are also concerns that funding coming from the Chinese side requires establishing and maintaining the company in China,” says Panetta. Still, Panetta is bullish: “China is moving forward on the healthcare delivery and drug development fronts at a speed that we can’t begin to imagine in the US.”

US biotech leaders are believers. “China is committed to become a leader in biologics,” says Magda Marquet, founder of San Diego-based Althea Technologies. Chinese companies have expressed interest in Althea’s biologics capability and protein delivery technology platform. “I have no doubt that five years from now, we’ll have a lot of collaborations in China,” says Marquet.

Marquet says the situation in China is very different from that in the US because there are many smaller companies, not a dozen leaders. Many have cash to invest, and they want to acquire a product pipeline. “It’s a real trend, and when the Chinese decide on a clear priority, they can move very fast,” says Marquette.

There are different ways to build bridges. “A common model is that a US company finds a Chinese partner to share R&D costs and risks to co-develop a new product. The Chinese partner earns the China commercial rights while the

US company retains the global rights outside of China,” says Jiang.

But there are other models. In April 2011, Jinzi Wu, a former GSK drug developer, used US\$100 million (¥633 million) in funding from a Chinese real estate magnate to launch Ascleitis. The company, which will have one foot in North Carolina’s Research Triangle Park and another in Hangzhou, will develop cancer and infectious disease therapeutics.

Not all Chinese companies building bridges with the US are product poor. Shenzhen-based Chipscreen Biosciences has three pre-clinical compounds and two late-stage products, all discovered internally. One, Chidamide, a new benzamide-type histone deacetylase inhibitor for peripheral T cell lymphoma, has obtained orphan drug designation for a clinic trial—a first of its kind in China. Whereas other Chinese pharmaceutical companies are shifting toward discovery, Chipscreen is expanding in the other direction. “Our strategy is shifting toward building internal capability for late-stage development in China, including a GMP facility,” says Lu. The GMP upgrade should help Chipscreen get certified by other regulatory agencies, including the US, where its partner, HUYA Biosciences, is finishing up a phase 1 clinical trial on Chidamide.

Legislating innovation

There are, however, problems that need to be resolved before this potential can be realized. With government support, much progress is being made.

The major problem is red tape. Everyone that does drug development in China complains about the same regulatory hurdle: to start a clinical study in China, a company has to wait for one year or longer to get approval. In other markets, this approval is often granted within two months.

This drives some away. A ‘green channel’ has accelerated the process for some drugs, says Hutchison’s Du. “But it is still longer than in the US and other mature markets. There is also room to improve in terms of the first-in-man requirements,” she adds.

The government is aware of the problem. This March, the Center for Drug Evaluation of China’s



According to Magda Marquet, founder of San Diego-based Althea Technologies, in their endeavor to become a leader in biologics Chinese companies have expressed interest in Althea's biologics capability and protein delivery technology platform.

State Food and Drug Administration issued the Principles and Procedures for Drug Technical Review and Evaluation which streamlines evaluation for innovative drugs. Under the new procedures, evaluators will be organized by their specialty rather than therapeutic area, allowing drugs to be evaluated on the basis of several parameters at the same time. Generic drugs will still undergo a "one-office, single disciplinary review."

"More detailed guidelines, more clear paths for dossier, and the green channel are certainly a plus to support innovation in China," says Chipscreen's Lu.

Additional concerns, however, are new pricing policies. This March, in an effort to drive down drug prices, the National Development and Reform Commission lowered prices for 162 drugs by some 20% on average. Similarly, the 'Anhui model', which aims to decrease the prices of 307 medicines on the essential drugs list, awards contracts to companies with the lowest price. But major drug companies are worried that this could favor small manufacturers that lack capacity and might fail in quality control. The result could be that China becomes a less attractive place for R&D investment and innovation.

Funding innovation

But make no mistake. The central government is intent on supporting drug discovery. The recently released Twelfth Five-Year Plan allocates ¥2 trillion (US\$308.5 billion) for science and technology, including ¥20 billion (US\$3.2 billion) for innovative medicine, the cultivation of new varieties of genetically modified organisms and the prevention of viral hepatitis. The initiatives, the government says, will create one million jobs by 2015. According to ChinaBio, the government has pumped more than US\$15 billion (¥95 billion) into programs ranging from drug discovery to commercialization.

Chipscreen's Lu says it is working: "The financial support for good laboratory practice and good clinical practice infrastructure is clearly creating the scale to bring sensible new treatments from China in future." The plan has given "renewed impetus" to the innovative biopharmaceutical industry, says Zhao. "Not only are academic institutes benefiting from additional government funding but also local Chinese commercial enterprises are receiving support for their R&D activities with a view to creating an industry that will participate in the global market."

Local governments are also getting in on the act. The Guangdong government is investing large sums in new biotech companies, including a ¥85 million (US\$13.4 million) grant to create a company that uses small interfering RNAs as therapeutics for inflammatory diseases. And the central and Shanghai governments combined ¥230 million (US\$36 million) for the initial construction phase of the 22,000-square-meter Shanghai Center for Systems Biomedicine on the Shanghai Jiao Tong University campus. The center supports post-genomic research and personalized medicine with facilities for proteomics, bioinformatics, molecular imaging, transgenic animals and tissue banking.

Yangtze's Xu sees great change ahead. "At present at all levels the Chinese government is putting more emphasis on new drug development and providing support for innovation and intellectual property protection."

Labor issues

A stickier problem could be labor costs. China's healthy supply of talent has been one of its main attractions. But, according to Scott of ChinaBio, although there is still a cost advantage of 30–40% or more in China over the US or other developed countries, a yearly 10% increase in salaries is quickly eroding that advantage.

"With the appreciation of the yuan, China's labor costs are increasing," says Lilly's Zhang. "Retaining experienced talent is a challenge. This is a major uncertainty and could impact Chinese competitiveness as an R&D destination."

"It is still a buyer's market for entry-level laborers," says Darren Ji, CEO and founder of PharmaLegacy Laboratories, a leading CRO in Shanghai. "But finding skilled staff is becoming more difficult especially in Shanghai and Beijing. This may become an issue for continued research expansion." Chipscreen's Lu says the problem is particularly severe in medical affairs, clinical research and the clinical study of new mechanisms of drug. "The medical evaluation system for clinic practitioners needs to be greatly improved if China wishes to become a major power in biomedical research and drug development," says Lu.

Still, Scott says, China's universities are producing 150,000 scientists each year and 130,000 scientists, engineers and business types returned from abroad just last year. "This is rapidly increasing China's ability to do sophisticated global business transactions," says Scott.

Companies are dealing with the tight labor market in different ways. Bayer, for example, is trying to woo employees by providing opportunities to

develop their careers by training with colleagues in the US or Europe.

Five years, ten years down the line?

Progress has been made, but more can be done if China plans to make the transition from generics and me-too drugs to the advancement of new, first-in-class and best-in-class medicines. "The latter requires a different structure and mindset that is not found at most Chinese pharmaceutical companies," says GIBH's Tortorella. "The transition will require a concerted effort from both the government and private sectors."

Lu is hopeful. "Although the current system of clinical research in China is far from satisfactory, we believe the situation can be improved quickly within the next five years through awareness of those existing problems by all stockholders," says Lu.

And while the clinical resources in China remain relatively untapped, especially for first-in-man, proof-of-concept and pivotal trials, R&D productivity in the preclinical stage will put pressure on the country's regulatory system to transform itself, says Lilly's Zhang. "Reforming requirements for first-in-man trials will bridge the gap between the preclinical R&D capabilities and late-phase international multicentered trials. A good place to start might be deferring requirements that are not critical to subject safety from investigational new drug to the new drug application stage, so as to put both regulatory and R&D resources into the best use," says Zhang.

Integration into global pipelines will continue and the research base will expand. "We expect by 2015, China will be fully incorporated into clinical development program. We also expect that our activities in China will significantly increase our global R&D capacity," says Merck's Dong. Others are similarly bullish. Scott says the influx of MNCs and transition of Chinese pharmaceutical companies to new R&D has created enough momentum. "IMS predicted that China will be the top pharmaceutical market in 2020, but I believe this will occur several years earlier," says Scott. AstraZeneca undertook a worldwide survey focused in 2010. "Although the US was rated the most innovative country in the world today, there is an expectation that both China and India will overtake the US by 2020," says Yang.

And the economy gives China an edge. "While the Western world is dealing with economic challenges and lots of uncertainty, China has the clarity, the drive and the capital to compete very significantly in drug development," says Marquet.

Just how quickly will the balance of pharmaceutical power shift in China's direction? Ji says it will take 10 years until "China will become the focus of attention in drug development. 'Made in China' will start transforming into 'discovered in China'," says Ji.

Things are moving in that direction so fast that Panetta is afraid to hazard a guess as to what the situation will look like in five years. A visit to the China Medical City in Taizhou, which Panetta says is "being constructed literally overnight" convinced him: "Five years from now, China will have created a foundation for drug development on a scale that we can only begin to imagine."



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Chengdu: A Burgeoning Bioscience Cluster in Western China

Chengdu is the well-connected hub for the biopharmaceutical industry in Western China.

The life science and health industry of China is entering a golden age, as the nation's most recent 5-year plan becomes fully implemented, putting into motion various health reform policies. Such policies include the expansion of health services to rural areas and the mobilization of substantial resources to foster growth of the industry. In the midst of these developments, Tianfu Life Science Park can be found nestled in the Chengdu High-Tech Zone, which ranks fourth among the 55 High-Tech Zones in China. Companies located in the zone benefit from a broad base of support mechanisms designed to promote business growth.

Built 2,300 years ago, Chengdu, the capital city of Sichuan Province, is known as the Land of Heaven owing to the fertile Chengdu plain and favorable growing conditions. Abundant harvests are characteristic of the region and have been for millennia, thanks to a feat of ancient engineering. The irrigation structure known as the Dujiangyan, built in 256 BC, protects Chengdu from extreme conditions such as drought or flooding. Today Dujiangyan dams provide irrigation for over 5,300 km² of land in the region. 'Tianfu' means 'paradise' to the locals, and the Tianfu Life Science Park serves as the city's financial, trade, scientific and technological center.

Local Resources and Global Growth Potential

Chengdu is already home to nearly 400 biomedical enterprises that cover various aspects of the industry, ranging from modern applications for traditional Chinese medicine, to synthetic drug formulation, optimization and production, biologics and biomedical engineering, drug packaging, and pharmaceutical research and development



Sichuan University (West China Campus) Gate
Sichuan University is one of China's key universities under the direct supervision of the Ministry of Education. The West China Hospital of Sichuan University, one of the busiest hospitals in China, is located across the street.



Chengdu City: A blend of ancient culture and modern civilization.

services. Blood-based products and major transfusion products manufactured in Chengdu account for one-third of the nation's market share. Furthermore, Chengdu's pharmaceutical and manufacturing industry's gross annual output ranks first in West China.

The natural resources located in and around Chengdu are a source of over 2,000 types of Chinese herbal medicines, which account for approximately one-half and one-third of those marketed in Sichuan Province and China, respectively. Not surprisingly, Chengdu is known as the 'hometown of traditional Chinese medicine' or the 'traditional Chinese drug warehouse'. The area dedicated to planting traditional Chinese medicinal materials, such as chuanxiong rhizome, curcuma root, Chinese goldthread and magnolia bark, is maintained at or above 400,000 mu (about 266,660 m²) throughout the year.

The Chengdu regulatory authorities have assumed a lead position in China through their standardization of policies (that is, Good Agricultural Practices and Standard Operating Procedures) for the planting, harvesting and processing of medicinal materials. Chengdu is an important national planting base for well-known regional drugs. Chengdu's role in the modern application of traditional Chinese medicine makes the area a prime location for business development. Its natural resources alone provide a deep well for drug discovery and development.

Chengdu's global position in other technology sectors means the logistics of travel and export are well established. The city has an excellent domestic sea, railway and road transport and logistics system. Chengdu is one of China's four major international airport hubs, with the largest airport in Midwest China and 34 international airways. The railway-sea combined transport logistics thoroughfare connects European, Middle East and Southeast markets via the Euro-Asian

Continental Bridge and the Pan-Asian Railway Line. In 2009, the comprehensive clearance capability of Chengdu customs ranked sixth among China's 41 customs offices and first in Midwest China.

Chengdu is regarded as a metropolitan area for bioscience employment. In 2009, the area boasted 42 general colleges and universities, more than 1,000 scientific research institutes, 589,000 university and college students and 146,000 graduates. Ten universities offer a major in pharmaceutical sciences, and 13 offer a major in chemistry. 12 vocational and technical colleges offer secondary technical training in pharmaceuticals. Nearly 10,000 professionals in various fields are trained each year. Chengdu has the world's largest clinical education training center, which is certified by the American College of Surgeons in Asia. Compared with other major cities of China, Chengdu has the additional advantage of being able to provide a talent pool at a lower human resource cost than can cities in coastal areas.

The Elements of a Biopharmaceutical Cluster

Universally, successful biopharmaceutical clusters encompass three elements: universities to drive innovation and train a scientific workforce, financing to support companies founded on innovation and, of course, laboratories and space for businesses to grow. Chengdu enjoys strong ties to the international community (eight consulates including those for the USA, Germany and Singapore are located there) and possesses all the elements necessary to support a burgeoning biomedical cluster. Chengdu boasts vast, rich natural resources (which have facilitated a leading position in manufacturing as well as traditional Chinese medicine), a large pool of professionals and numerous research institutions, universities and hospitals. Among



them are Chengdu Institute of Biology of the Chinese Academy of Sciences, Chengdu Institute of Organic Chemistry of the Chinese Academy of Sciences, Chengdu Institute of Biological Products of the Chinese Academy of Medical Sciences, and Sichuan Industrial Institute of Antibiotics. The region is thought to have the highest density of R&D institutes in West China.

The pharmaceutical industry is emerging in Chengdu; 63 medical enterprises have each achieved an annual turnover exceeding 10 million CNY per year (about US\$1.6 million). Initial public offerings have been successfully launched by at least four companies—namely, Kelun, Huashen, Zhonghui and Dikang. The Chengdu Institute of Biological Products is collaborating with the not-for-profit PATH Foundation to develop vaccines. Di'ao Xinxuekang, produced by Di'ao Group, received GMP certification from the Netherlands and is positioned to be the first therapeutic traditional Chinese medicine to enter the EU market.

The resources available for preclinical and clinical drug development are extensive. For example, West China Hospital of Sichuan University is among the 20 hospitals serving 35.9 million people in the area and is considered one of the busiest hospitals in China. In addition to a network of contract research organizations, specialized animal research facilities are available that provide access to animal models. The Ping'an Monkey Park keeps more than 2,000 rhesus monkeys for clinical purposes. In an effort to reduce the cost of new drug development, Chengdu High-Tech Zone is setting up a series of public platforms, which include a drug screening center, a chemical analyzing and testing public platform, a preparation research center, and a pilot-scale producing center with GMP.

Chengdu High-Tech Investment Group and other financial institutions are providing capital investment through various financial mechanisms. Tax credits and investment incentives for research and life science companies are provided by the regional government agencies. Regarding space for businesses to grow, the Tianfu Life Science

Park provides public laboratory space and business incubation facilities.

Tianfu Life Science Park

As the gateway for the life science industry in Western China, Tianfu Life Science Park is supported by the Chengdu municipal government and the Chengdu High-Tech Zone. Construction of a 221,553 m² area has been completed. Within the park are many biomedical and medical enterprises providing products and services, both within the Chinese market and abroad. The park is home to the West China Hospital Medical Transformation Center. Another park resident is the fast-growing Renhe Pharmaceutical Group.

BioTianfu Forum

Chengdu Municipal Bureau of Science and Technology, Chengdu High-Tech Zone Administrative Committee and the Tianfu Life Science Park believe in doing more to foster biomedical entrepreneurship than simply providing space in a prime location. These organizations have launched the BioTianfu Forum initiative to provide a platform for scientific exchange between companies in the area and leading industry, university and research organizations from China and abroad.

The forum enables experience sharing through customized interactive lecture sessions, panels, roundtable meetings, and site visits. To date, the forum has featured speakers from government (China's Ministry of Health), industry (namely, Astra Zeneca, UK) and research institutions (University of British Columbia, Canada, and Southern Biotechnology Foundation, TX, USA). Participants have attended the forum to present on various topics such as innovative drug development strategies opportunities for growth and the state of the industry in Chengdu.

The BioTianfu Forum was also created to attract attention to the area, integrate innovative resources, and promote the industry. The Canada-based Heracles Investment Company has signed a memorandum of understanding

CHENGDU AT A GLANCE

- 11.4 million people; 12,400 km² land area; the metropolis in Southwest China with a well-educated community
- Industrial gross output value ranks first in Western China
- More than 400 bioscience companies, of which 230 each have an annual primary business revenue of over 10 million CNY (about US\$1.6 million)
- 64 colleges, universities and scientific research institutes, 8 national and provincial laboratories, 14 national and provincial engineering technology (research) centers and enterprises technology centers
- Over 2 million current students and over 500,000 graduates every year
- West China Hospital of Sichuan University is among the busiest in China
- Sales revenues in medical trade and commerce reached 28.37 billion CNY in 2010
- Infusion and blood products supply one-third of China's domestic market
- The comprehensive clearance capability of Chengdu customs ranks sixth among China's 41 customs hubs and first in Midwest China
- 972 bioscience-related patents were granted in 2010, accounting for two-thirds of those issued in Sichuan Province
- 410 cases of registrations of new medicines were approved by the state between 2005 and 2010

with Sichuan Yuanda Shuyang Pharmaceutical Co.. Human albumin, human immunoglobulin (pH4) for intravenous injection and human hepatitis B immunoglobulin are among the products manufactured by Sichuan Yuanda Shuyang. The blood product market in China has great potential for further development owing to the size of the population and sustained economic growth.

With the support of the BioTianfu Forum, the bioscience industry of Chengdu should enjoy greater resources and faster growth through cooperation and exchanges, and expect to become part of the global labor force and competitive in the global industry, establish global strategic partnerships, and foster maturation of Tianfu Life Science Technology Industrial Cluster.

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The Tianfu Life Science Park is an important innovation and incubation center for biomedical research and development and serves as a platform for the cooperation between international medical/clinical institutions.

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- 新抗原的开发，及抗原发现与鉴定的方法；
- 载体蛋白和蛋白多糖结合技术或替代技术；
- 疫苗给药的新方法；
- 适合于鼻腔或口服使用的疫苗载体。

增强疫苗免疫应答的制剂

- 佐剂和免疫调节剂；
- 用于增强或改变免疫应答类型的疫苗载体和递送系统；
- 用于开发新型佐剂和免疫调节剂的生物学和免疫学研究。

免疫应答与疾病标记物的鉴定和分析

- 人类疾病的动物模型；

- 人体组织的体外模型，包括免疫系统的相关模型；
- 用于评价预防或治疗效果的生物标记物；
- 与疫苗使用和免疫治疗相关的流行病学研究。

提高疫苗和单克隆抗体的研究、开发和生产的工具，例如：

- 基因组学和蛋白质组学领域新技术的开发和应用；
- 用于抗原生产的原核细胞或真核细胞系；
- 发酵罐和生物反应器技术；
- 一次性使用系统；
- 在线检测；
- 下游处理、纯化和无菌分装工艺；
- 过程自动化技术；
- 防腐剂和稳定剂；
- 计算机建模、数据处理与分析的生物信息技术；
- 防伪技术。

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Global Service Provider Wuxi AppTec Expands to Wuhan

Wuxi AppTec will be adding to its extensive outsourcing network. The new facility under construction in Wuhan will be operational in Q1 2013

The Wuxi AppTec, listed on the New York Stock Exchange and headquartered in Shanghai, is the eighth largest medical R&D outsourcing service company in the world, and the largest in China. The group encompasses large-scale R&D and production bases in eight cities across China and the U.S., and a global staff of 5,200. A new facility located in the China's Midwest capital city of Wuhan, is being added to the Group.

The company primarily provides global pharmaceutical giants and biochemical companies with quality and efficient new drug R&D services and products. It has established solid partnerships with more than 100 pharmaceutical enterprises, including the top 20 pharmaceutical companies and top 10 biochemical companies in the world. The Group has the world's leading drug template technology, efficient parallel synthesis and separation purification technology, and multichannel parallel virtual screening technology and nearly 200 patents covering their proprietary platform technologies. The company's total revenue reached US\$334 million (approximately 2.2 billion RMB) in 2010.

In China, the company also has a 105,000m² R&D center in Shanghai Waigaoqiao Free Trade Zone (WFTZ), a process R&D and cGMP production base of 53,000m² in Jinshan District, Shanghai, a 24,000m² R&D center mainly providing medical R&D chemical services in Tianjin, a 30,000m² toxicology center in Suzhou, as well as a 32,000m² biological drug R&D pilot test base in Wuxi. The three facilities in the USA including: the R&D and 7,600m² production center in St. Paul, Minnesota, the 4,700m² testing center in Atlanta, Georgia, and the 7,000m² R&D, testing and production center in Philadelphia, Pennsylvania; have all passed review by the U.S. Food and Drug Administration. In 2010, the company embarked on further expansion with plans for another facility in Wuhan.

Wuhan AppTec Co., Ltd.

In November 2010, Wuxi AppTec Co., Ltd. (holding 60% shares) and Wuxi AppTec (BVI) Inc. (holding 40% of shares) jointly established Wuhan AppTec Co., Ltd. Wuxi AppTec Co. has a registered capital of US\$29.8 million and a total investment of US\$88 million. Wuhan AppTec will become the largest medical R&D base in Midwest China by deriving techniques, talents and brand strengths from its parent company. The company intends to invest



Plans for the Wuhan AppTec facility include three buildings dedicated to R&D comprising a total of 10,000m², and two additional buildings for office space and support facilities.

US\$20 million in introducing a series of high-end instruments and equipment such as the internationally advanced resonator, liquid chromatograph mass spectrometer, and supercritical fluid chromatography instrument, in order to research and develop new drugs and provide domestic and foreign customers with drug template and compound library designs, synthesis, structural optimization, process R&D, analytical testing, and other R&D services.

The Wuhan AppTec project covers a total area of 52 mu, and total construction area of 40,000m². The plan includes five buildings, three R&D buildings comprising a total of 10,000m², one 8,000m² office building and one 2,000m² supporting facilities building.

The project commenced in Q4 2010. Currently, the framework and internal brick for a total area of 12,000m² (including the supporting facilities building and one laboratory building) has been completed. Installation of the laboratories and equipment is in progress and the work will be completed in late November 2011.

Presently, Wuhan AppTec has already recruited 148 employees and made most of its equipment purchases. The framework of the

remaining three buildings will be completed before the end of this year, and is expected to be fully operational in early 2013. After completion of the construction Wuhan AppTec will engage as many as 2,000 employees among which 1,500 will be scientists (including 200 doctoral students and 1,000 graduate students) and 50 high-end overseas talents. The Company is projected to achieve a revenue of 50 million RMB (about US\$7.8 million) by 2012 and of RMB 600 million (US\$94.1 million) by 2016.

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BGI's Collaboration with Healthcare

With the largest sequencing capacity in the world, BGI is poised to have an impact on the field of rare diseases and other areas of healthcare

Since its inception, the endeavors of BGI (previously known as the Beijing Genomics Institute) have been characterized by the importance of promoting openness and international collaboration. "Science can never be performed alone, and BGI's rich history is best represented by its extensive international collaborative activities," emphasized Dr Jun Wang, Executive Director of BGI Shenzhen, China.

BGI has taken part in every major international genome-sequencing project of the past decade. Some of the healthcare and pharmaceutical high points include: the sequencing of the severe acute respiratory syndrome (SARS) coronavirus genome and the International Human HapMap Project, which aims to provide a public resource that will help researchers find genes associated with human disease. BGI is at the crux of other efforts that are positioned to have an impact on human disease, such as the 1,000 Mendelian Disorders Project.

As the institute takes on genetic diseases with genomics and other sequencing applications, BGI is looking for collaborators to sequence 1,000 Mendelian Disorders in humans. "We seek collaborations from all over the world to investigate the molecular basis of Mendelian disorders for promoting early prediction, diagnosis and intervention," explained Bicheng Yang, Marketing Director of BGI in Shenzhen. The project promises to yield some practical clinical applications. For example, the use of exome sequencing (which concentrates on the transcribed regions of the genome) identified a novel causative gene for spinocerebellar ataxias — transglutaminase 6 (TGM6) [*Brain* **133**, 3510–3518 (2010)].

Autosomal dominant spinocerebellar ataxias encompasses a large, heterogeneous group of progressive neurodegenerative diseases that manifest as a slow loss of coordination that may impact hand movements, gait or eye movement. Use of a combined strategy of exome sequencing and linkage analysis elucidated a novel spinocerebellar ataxia causative gene. A missense mutation in TGM6 was identified by sequencing the exomes of a four-generation sample from a Chinese family with spinocerebellar ataxia. The change was detected at a highly conserved position, is predicted to have a functional impact, and is completely co-segregated with the phenotype. The finding also illustrates whole-exome sequencing of affected individuals from one family as an effective and cost-efficient method for mapping genes of rare Mendelian disorders.

As a member of the International Cancer Genome Consortium (ICGC), BGI is taking part in the international effort to harmonize how genomics and its applications, such as transcriptomics

and epigenomics, are used to comprehensively evaluate the genomic changes that are present in many forms of cancers. The ICGC has committed to a comprehensive description of 50 different tumor types. A database for common and rare tumors will be created, and biomarkers and new drug targets will be pursued. BGI is applying exome sequencing to hone in on the multiple mutations associated with gastric cancer. Complementary studies on mutation frequency and structural variations will be assessed using low-depth whole-genome sequencing, and transcriptome analysis from RNA sequencing will help to further illuminate the spectrum of cancers that exist.

At the foundation of BGI are the cutting-edge research technologies and IT platforms that support efforts to find new ways of detecting and treating human diseases. Powered by 137 Illumina HiSeq 2000 system and 27 Applied Biosystems SOLiD 4 systems, BGI's sequencing platform possesses the largest sequencing capacity in the world. The capacity to store, process and analyze enormous amounts of bioinformatics data is accessible through BGI's high-performance supercomputing centers. BGI boasts a total of 102 T flops, 20 TB of memory and 10 PB of storage. Finally, the Bioinformatics Centers of BGI support large-scale DNA sequencing by providing data collection, processing, management, deep mining and a Cloud computing system. "We are working to maximize the value of massive amounts genomic data from human and numerous other organisms to further our understanding of biology and improve human health," explained Yang.

And In The Private Sector

From an industrial perspective, BGI can approach nearly every aspect along the drug development continuum from many angles, such as the identification of target genes and changes in transcription proteins and metabolism. BGI helped to complete the sequence for the Chinese hamster ovary (CHO-K1) genome, an accomplishment that will augment industry bioreactor optimization capabilities. This is a collaborative effort between BGI and GT Life Sciences (San Diego, CA, USA) a biotechnology company that specializes in the manipulation of cell metabolism. The CHO-K1 cell line is important to both pharmaceutical research and the production of therapeutic proteins. An understanding of CHO genomics will spawn wide-reaching applications, such as accelerating the discovery and development of new recombinant protein therapeutics and



Merck has entered into a collaboration with the BGI to explore areas such as biomarkers, target validation, and decreasing the risks associated with drugs and their development.

increasing the efficiency of CHO cells in the process of protein production.

Recently, Merck was added to the institute's long list of pharmaceutical company collaborators (namely, Pfizer, GlaxoSmithKline, Novartis, Johnson & Johnson and Lilly). "The collaboration is unprecedented and promises to be a potent undertaking that will truly impact the healthcare industry," described Yang. BGI and Merck will provide infrastructure to support collaboration in areas such as biomarkers, target validation, and decreasing the risks associated with drugs and their development. The Merck agreement came about not long after BGI opened international facilities in Boston (BGI Americas) and Copenhagen (BGI Europe) to further BGI's mission: to make leading-edge genomic science highly accessible.

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Hong Kong Science & Technology Parks Corporation

www.hkstp.org



Hong Kong 香港科技园
Science & Technology Park

The alpha-rated delta bioregion

Hong Kong — well known for its free economy, international business environment, simple and low tax system, and sound protection of intellectual property rights — is now building on its reputation as a research and development engine. Its geographical and historical associations give Hong Kong not only a position to establish the city as a key part of the international scene but also, of course, unrivalled access to the rest of China. For many high-tech industries, this relationship has led to a value chain that stretches across the Pearl River Delta (PRD) region, with Hong Kong as a location for corporate headquarters and research and development (R&D) facilities, while Shenzhen serves as the manufacturing base. Under the Mainland and Hong Kong Closer Economic Partnership Arrangement (CEPA), an accord like a free trade agreement, this value chain is reinforced because many Hong Kong goods and services can enter China tariff-free.

Hong Kong is also increasingly recognized as an international education centre, home to world-leading research universities that are especially strong in life sciences and biomedical areas. Bibliometric surveys commissioned by Hong Kong Science & Technology Parks Corporation (HKSTPC) indicated that Hong Kong's biomedical research not only accounts for 20% of the research published from China in international journals but it also leads other Chinese regions in terms of citation criteria. The broader study in which the citation data appeared (Capturing the Delta Opportunity: <http://bio.hkstp.org/HKSTPC/bio/index.jsp>) identified a number of research projects with commercialization potential and concluded that Hong Kong has the resources to grow a thriving biomedical cluster that could serve as a hub for the entire HK-PRD region.

Biotechnology incubation program

For young local growth companies and for expanding inward investors in life sciences, Hong Kong Science Park, managed by HKSTPC, now offers dedicated incubation units at the Biotech SME Centre. With phase 2 development of the Centre completed in 2009/10, ready-to-use laboratory units now number 18 and there have been additional investments in shared equipment to supplement access to facilities such as meeting rooms and the biotech support laboratory. In addition, each company can be allocated its own wet laboratory and small office. To assist biotech start-up companies through their most vulnerable inception stages, HKSTPC offers a maximum incubation period of 4 years, with rent-free occupation of the first 800 sq ft of laboratory/office space in the first year, and reduced rental



in subsequent years. Additional support comes in the form of subsidies of up to HK\$851,000 for 4 years, calculated as 50% to 75% of actual expenses.

Several life sciences sub-clusters have grown within Science Park. These include groups of companies in Chinese/herbal medicine, food, medical devices, and regenerative medicine. The regenerative medicine group now represents nearly 19% of all the life science companies in the Park due, in part, to the presence of world class research groups and easy access to research materials and patient groups. The regenerative medicine and other life sciences sub-clusters are also fully supported by the state-of-the-art shared facilities providing genome sequencing, genotyping, amplification and quantification; protein identification, characterization and quantification; and ultra-sensitive instruments for analysis such as drugs, metabolites, chemicals, carbohydrates, proteins steroids, and pesticides.

For clinically-oriented companies, Hong Kong also has world-class clinical trial centers that are unique in that trial results in a number of therapeutic areas are accepted by both the US Food and Drug Administration (USFDA) and the Chinese State Food and Drug Administration (SFDA). Hong Kong is also establishing a Testing and Certification Centre for Chinese/Herbal

Hong Kong Science and Technology Parks Corporation (HKSTPC) is a statutory body set up by the Government of the Hong Kong Special Administrative Region.

HKSTPC manages Hong Kong Science Park, InnoCentre and three Industrial Estates located at Tai Po, Yuen Long and Tseung Kwan O.

HKSTPC provides technology-driven infrastructure and support facilities which include market focused, clustered laboratory services. It also provides full service incubation programs for start-up companies, and fosters partnership and collaboration between industry and universities/applied research institutes through consulting, training and research programs.

Medicine and Food, a move that complements the presence in the Science Park of companies such as Purapharm International (one of the major Southern China players in extracted products), Bionorica (a German herbal drug company), and major food concerns such as Diageo (a major British purveyor of branded drinks), Seperex Nutritionals (a New Zealand-based leading manufacturer of dairy supplements in Asia Pacific), and Alimentary Health Asia.

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