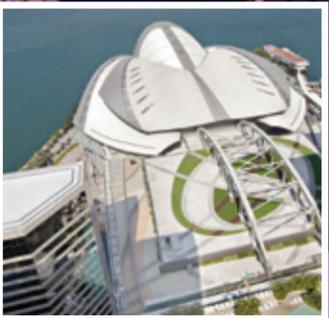
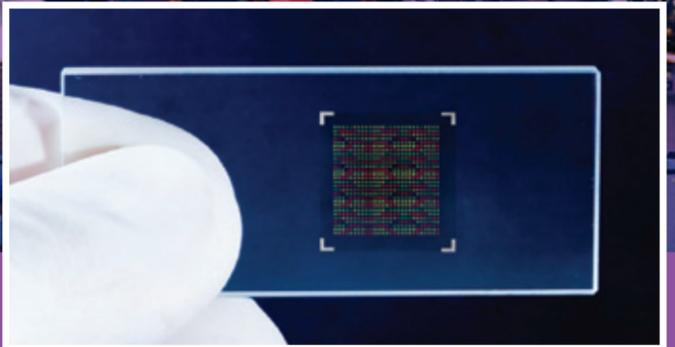
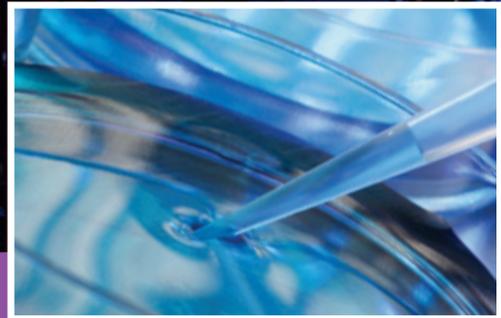
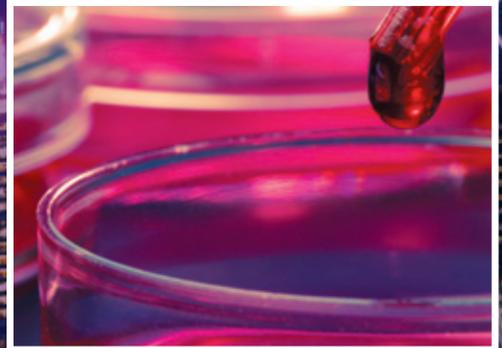


HONG KONG IN FOCUS: Asia's Research Hub



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HONG KONG IN FOCUS: Asia's Research Hub



Contents

Positioned at the crossroads of Asia and the West, both geographically and culturally, Hong Kong is taking advantage of its auspicious place in Asia by reimagining itself not just as a financial and tourism center, but also as a research and biotechnology hub. This sponsored feature will provide the reader with an update on the state of scientific research in the region and a glimpse into the powerful engine that is driving progress there, from basic research to the commercialization of therapeutics and medical devices.

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Overview

Hong Kong is a special administrative region of China with a population of seven million. As a former British colony, handed back to China in 1997, Hong Kong still contains a unique blend of East and West. Its educated, multilingual populace speaks Cantonese and Mandarin, while English continues to be the language used in business, education, and research and development. This makes Hong Kong an attractive place for international talent and a bridge between Asia and the rest of the world.



Chun-Ying Leung

Hong Kong is best known as a financial center and the business capital of Asia. However, biotech is an emerging sector that has been designated a key industry for development. "We have to focus on developing a key area we identify to have huge potential, and grow it to assume a leading position globally. It is well-recognized that Hong Kong possesses what it takes to become a high-tech hub, and we are hoping to unify the efforts of the government, up-stream academia, and mid- to downstream industry," says The Honorable Chun-Ying Leung, chief executive of Hong Kong, in a recent interview with the Hong Kong-based newspaper, Wenweipo. The Hong Kong Government is determined to promote biotech as a key industry. Six key industries have been developed and intensively promoted, of which four are closely related to biotech, namely innovation and technology, testing and certification, medical services, and environmental industries. The remaining two areas are educational services and creative industries.



Nicholas Brooke

Hong Kong Science and Technology Parks Corporation (HKSTPC) exemplifies what can be achieved under this paradigm. "The advantages of performing biotech research and development in Hong Kong are myriad. Under the 'one country, two systems' doctrine, Hong Kong has protected intellectual property [IP], internationally recognized enforcement of common law, free media, academic freedom, and a sound financial and banking system which can provide a platform for fundraising. Hong Kong Science Park provides the infrastructure, support programs, and collaboration opportunities to nurture the growth of our biotech industry and to support Hong Kong to grow into a knowledge-based economy," says Mr. Nicholas Brooke, chairman of HKSTPC. Their 22 hectare Hong Kong Science Park currently provides laboratory and office space to almost 400 technology companies.

Today, there are 250–300 biotechnology companies in Hong Kong,

70 with substantial mainland background. Hong Kong's total R&D expenditure recently more than doubled from HK\$5.9 billion (US\$761 million) in 1999 to HK\$13.3 billion (US\$1.7 billion) in 2010. The number of full time R&D employees also doubled, from around 10,000 to 24,100 during the same period. Government support also comes in the form of the Innovation and Technology Fund (ITF), set up in 1999, which aims to support mainly applied R&D projects conducted by universities, industry support organizations, industry and trade associations, and private sector companies that contribute to the innovation and technology industry. "As of October 2012, HK\$7.1 billion (US\$916 million) of ITF funding has been approved for 3,066 projects, of which around seven percent went into biotechnology-related applications," says Miss Janet Wing-Chen Wong, the commissioner for Innovation and Technology.

Professor Albert Cheung-Hoi Yu, chairman of the Hong Kong Biotechnology Organization (HKBIO), emphasizes that this special feature outlining Hong Kong's biotech capabilities is a strong signal to the international community of where the city is heading. "A number of very

It is well-recognized that Hong Kong possesses what it takes to become a high-tech hub.

-The Honorable Chun-Ying Leung

active, fast-growing biotech players from the government, academia, and industry are featured. But this is not an exhaustive representation of what Hong Kong has." Examples of other crucial components of Hong Kong's biotech include the Hong Kong Medical and Healthcare Device Industries Association, The Hong Kong Association of the Pharmaceutical Industry, Hong Kong Business Angel Network, and the quasi-government run Hong Kong Productivity Council, amongst others. Education-wise The Open University of Hong Kong and the Vocational Training Council are, among other higher and continuing education institutes, supplying biotech talent in Hong Kong. "Many other outstanding professors and researchers also contribute significantly to Hong Kong's biotech advancement into a globally outstanding research hub," added Professor Yu.

"With world-class universities, Hong Kong is strong in basic research and making progress in the nurturing of industry. Its unique geographical and political position, and close economic ties to the mainland, allows its biotech industry to benefit from China's R&D drive," says The Honorable Regina Suk-Yee Ip Lau, honorary advisor of HKBIO and member of the Executive Council, Government of the Hong Kong SAR. Indeed, Hong Kong is rapidly becoming the chosen location for both global companies who want to access the fast-growing market in mainland China and for Chinese companies wanting to reach the rest of the world.



Regina Suk-Yee Ip Lau

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Innovation and Technology Commission www.itc.gov.hk

The Innovation and Technology Commission (ITC) was set up in 2000 to enhance Hong Kong's innovation and technology capability as an impetus for economic growth by supporting applied research and development, and technology transfer and application, providing technological infrastructure, and nurturing the development of human capital.

"Our basic policy is to create an ecosystem within which the innovation and technology sector can survive and flourish," explains Miss Wong.

The attraction of Hong Kong according to Miss Wong are its geographical location in Asia, the use of the common law system, the simple and affordable tax system, a clean government, and credible IP protection. Additionally, the region has universities that persistently rank among the top 50 in the world.



Janet Wing-Chen Wong

Importantly, the living environment of Hong Kong in terms of language, mobility, convenience, and familiarity has created a culture attractive to people from all over the world. "It is a good place for foreigners to connect with businesses in the mainland and Asia," says Miss Wong. "For big Chinese companies, Hong Kong is a good place to work towards the international market. We are really right in the heart of Asia."

Despite this, biotech in Hong Kong is a relatively young technology sector. However, health care-related companies, such as pharmaceuticals, medical devices, diagnostics, and traditional Chinese medicine, are growing. "Modernization of traditional Chinese Medicine [TCM] is increasingly showing huge potential and provides the perfect East-West integration that is crucial for Hong Kong's portfolio," adds Miss Wong.

"For biotech, proximity to the mainland provides oppor-

Our basic policy is to create an ecosystem within which the innovation and technology sector can survive and flourish.

-Miss Janet Wing-Chen Wong

tunities. Although Hong Kong is relatively small, it shouldn't be considered in isolation," states Miss Wong. Hong Kong is partnered with 12 of the 260 State Key Laboratories in the mainland China (with more to come), 10 of which have a biotech-related research focus. ITC, in collaboration with the Research Grants Council, ensures that these laboratories meet international standards with regards to infrastructure, workforce, and research focus.

Miss Wong expects biotech in Hong Kong to flourish and develop in the future. "We are certain that more international partners, including academics and companies, will join us in the future," she says.

Hong Kong Biotechnology Organization www.hkbio.org.hk

Hong Kong Biotechnology Organization (HKBIO), a charitable biotech industry organization, was established with the objectives of advancing and accelerating Hong Kong's biotech industry growth by promoting study, research, education, and exchanges in the biotech sector in Hong Kong. "Building an industry requires concerted effort from government, academia, and industry," explains Professor Yu. "We want to show the international community that Hong Kong is fully committed to building and growing this industry and that our government, academia, and industry are all taking proactive roles in contributing to biotech."



Albert Cheung-Hoi Yu

We want to show the international community that Hong Kong is fully committed to building and growing this [biotech] industry.

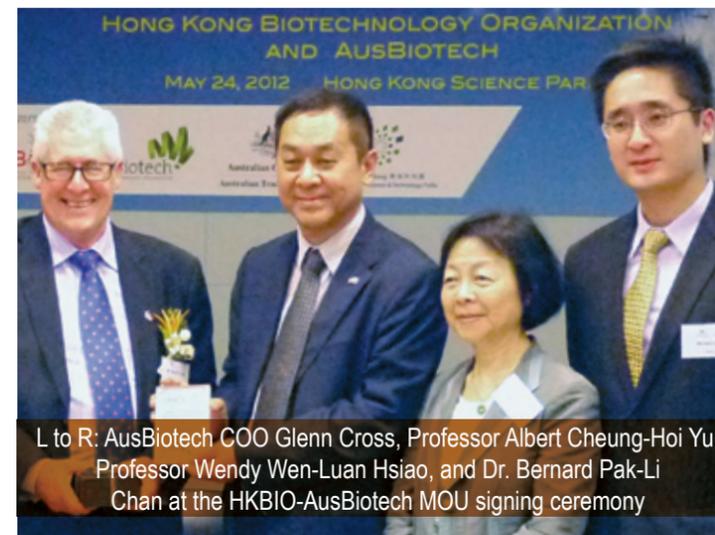
-Professor Albert Cheung-Hoi Yu

"HKBIO has extensive connections worldwide, bringing together local companies and potential global partners," says Dr. Bernard Pak-Li Chan, HKBIO Council Member. Some examples include the signing of memoranda of understanding with

the Taiwan Bio Industry Organization and AusBiotech, and the various delegations to build global platforms for industry.

"In general it is hard to attract funding specific for the biotech industry, so part of HKBIO's mission is to bring in venture capitalists and other funding agents to our industry, so that they will have opportunities to match each other's needs and resources," says Professor Wendy Wen-Luan Hsiao, HKBIO treasurer.

"One of the initiatives is to assist our industry to explore the China market. Hong Kong is the gateway to China," says Professor Yuk-Lam Lo, HKBIO honorary chairman. "It is very easy for us to go into China to do business and utilize the resources, including talent, financial grants, and the future market," adds Professor Yu. "In China, the demand for medical care, medical diagnosis, and treatments will be huge. The market in America is already saturated, but in China, you cannot calculate how much it might be worth."



L to R: AusBiotech COO Glenn Cross, Professor Albert Cheung-Hoi Yu, Professor Wendy Wen-Luan Hsiao, and Dr. Bernard Pak-Li Chan at the HKBIO-AusBiotech MOU signing ceremony

CREDIT: © ISTOCKPHOTO.COM/DIMBAKER

Hong Kong Science and Technology Parks Corporation

www.hkstp.org

Located at the waterfront of Tolo Harbor adjacent to The Chinese University of Hong Kong in the New Territories, the 22-hectare Hong Kong Science Park, which is managed by Hong Kong Science and Technology Parks Corporation (HKSTPC), was constructed to attract technology firms to base operations and R&D in Hong Kong. Phase 1 of the Park was opened in 2002 with Phase 3 due to be completed in stages from the end of 2013 to 2016.

“Our vision is to help Hong Kong build its capability in technology and innovation development,” explains Mr. E. Anthony Tan, chief executive officer of HKSTPC. “And to turn discoveries and new inventions from an idea or concept into a commercial product or service.”

To enable this, HKSTPC offers state-of-the-art infrastructure and offices for applied R&D activities, and shared laboratories with technical support to help reduce capital investment of R&D companies in product design and development. The five major technology clusters in the Park include electronics, information technology and telecommunications, precision engineering, biotechnology, and green technology. Around 55 of the 400 companies based in the Park work in biotech, employing roughly 800 people. The Park is currently 95 percent occupied; Phase 3 will provide another 50 percent capacity.

Gathering like-minded industries together was crucial to the Park’s design. “One important element of the Park is the clustering effect,” says Mr. Tan. “By focusing on certain technologies we can pool the right companies together who can create new ideas and challenge each other.

Among the five clusters, biotech is one of the important sectors for the 21st century,” adds Mr. Tan. “Many of the the issues in health and life sciences depend on biotech to provide solutions.”

“Our vision is to help Hong Kong build its capability in technology and innovation development.”

-Mr. E. Anthony Tan

“We provide a platform to facilitate: we support mature and medium sized companies,” explains Mr. Young. “More importantly, one of our main focuses is to support the startups, nurturing them and helping them with financial and non-financial support.”

HKSTPC’s incubation programs provide not only low-cost accommodation, but also management, marketing, financial, and technical assistance during the crucial first two to four years in the lives of startup companies. Incubatees can apply for a financial aid package worth up to HK\$860,000 (US\$112,000) over a four-year period. Beyond this, HKSTPC also implements a small and medium-sized enterprise program which helps companies with financial and legal services, office space, shared facilities, and more.

Beyond this, Hong Kong Science Park is an important new part of Hong Kong’s infrastructure as it turns itself into a regional hub for innovation and technology. “Many think of Hong Kong as a tourist spot, a trading center, and a logistics center. But not yet as a technology center. So we really need to focus on making a difference at the Park. We want to show the world that Hong Kong is capable of excelling in developing selected technologies,” explains Mr. Tan.

Mr. Young believes that the Park will be part of the community. “We serve the local community and also act as a platform for overseas technology companies to capture the Asia market,” he explains. “We also enable Chinese technology companies to use Hong Kong as a base for their own internationalization.”

Moving beyond Hong Kong itself, HKSTPC works closely with Chinese authorities at the national and provincial levels, as well as with a technology park in Guangzhou, mainland China. HKSTPC is also currently improving shipping methods on both sides of the Hong Kong-China border to allow for the smoother exchange of samples between R&D laboratories.

Andrew Meng-Cheung Young, vice president of Marketing and Sales for HKSTPC, believes the Park works as a bridge between academic research and commercial products or solutions.



Andrew Meng-Cheung Young

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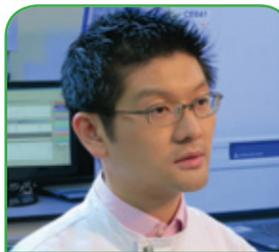
“It’s very important to collaborate with China,” agrees Mr. Tan. “It’s an area from which we can draw a lot of resources in terms of technicians, engineers, and scientists. We can also leverage Hong Kong’s ability to attract the best and brightest from around the world. HKSTPC can help develop breakthrough technologies using Hong Kong’s unique environment.”

Mr. Young is looking towards a bright future for HKSTPC. “Hong Kong is not yet known as a place for science and technology development. But some very innovative technology developers and entrepreneurs are willing to take the plunge. Hong Kong is much more than a physical location: it is a living community—that is what Hong Kong Science Park is all about.”

Multigene Diagnostics, Ltd.

www.multigene.com.hk

Multigene Diagnostics, Ltd. (Multigene) is a spin off from the City University in Hong Kong and the first biotech company admitted into the Incu-Bio Business Incubation Program of HKSTPC in 2009. The company is developing a range of molecular diagnostic assays using multiplexed fluorescence and array-based platforms for detection of infectious pathogens and genetic diseases, and for early screening and mutation typing of cancers.



Lawrence Chi-Hung Tzang

Lawrence Chi-Hung Tzang, executive director of Multigene. “We are collaborating with universities in Hong Kong and mainland China, where the government has significantly increased the investment in research and development in recent years.” In addition to its R&D capability, Multigene has established an ISO15189:2007 accredited medical laboratory in Hong Kong Science Park, the first in the private sector in Hong Kong. “All our products are validated and offered as clinical testing services to local physicians and diagnostic laboratories. This will significantly shorten the time it takes when the products go through clinical trials and regulatory processes of SFDA [China’s State Food and Drug Administration] required for entering the mainland market,” explains Dr. Tzang.

The rapidly growing Chinese economy and the increased purchasing power of the population, coupled with an increased awareness of wellness and preventive medicine, and the desire for cutting-edge products and services, make the future outlook extremely positive for molecular diagnostics in the China market. “We have a number of products that are in great demand in China, such as the human papillomavirus (HPV) detection and genotyping kits for cervical cancer screening,” says Dr. Tzang. “The other products that are ready for market include a multiplexed detection kit for 10 common sexually transmitted disease pathogens, an ovarian cancer screening kit, and a series of mutation

detection kits for personalized cancer therapy.” Multigene plans to set up a manufacturing unit within a year and establish a marketing and sales network in mainland China.

Bio-Cancer Treatment International, Ltd. www.bio-cancer.org

Bio-Cancer Treatment International, Ltd. (BCT), a local biotech startup, was established in 2001. Dr. Paul Ning-Man Cheng, CEO of BCT led the project to develop pegylated recombinant human arginase (BCT-100), together with Polytechnic University’s (PolyU) Professor Yun-Chung Leung and Associate Professor Dr. Wai-Hung Lo.



Paul Ning-Man Cheng

“BCT tests the hypothesis that human recombinant hepatic arginase I, after suitable pegylation to lengthen its circulatory half-life, can safely deplete plasma arginine for a prolonged period of time,” explains Dr. Cheng. “Once this state of arginine depletion is achieved, we test whether it induces remission in certain cancers that are auxotrophic for the amino acid arginine.” The goal is to provide a cancer treatment that is free of the side-effects usually associated with cancer chemotherapy.

Dr. Cheng believes that BCT’s research is particularly relevant in China. Their main target is liver cancer, which is very prevalent in the region. “Over 45 percent of the world’s liver cancer cases are found in China and Southeast Asia,” says Dr. Cheng, whose project was incubated at PolyU with funding from a private venture capitalist group and Hong Kong’s Innovation and Technology Commission.

Following optimistic preclinical results, BCT plans to commercialize the new drug. Phase 1 clinical trials for liver cancer treatment have been completed, with phase 2 starting this year alongside phase 1 trials for refractory lymphomas and leukemia.

“This is the first homegrown drug that has gone through the United States’ Food and Drug Administration process and is cleared for use on humans in the U.S. and Hong Kong,” says Dr. Cheng. “We have

good clinical data and, most importantly, there are no adverse side effects.” This is an achievement which has been hailed as an important milestone in the development of the biotechnology and pharmaceutical industry in Hong Kong.

Lee’s Pharmaceutical Holdings, Ltd. www.leespharm.com

Lee’s Pharmaceutical Holdings, Ltd. (Lee’s Pharm), is a public biopharmaceutical company that has operated for over 18 years in China, carrying out drug development and clinical research, as well as regulatory, manufacturing, sales, and marketing activities. Currently, 12 of its products are marketed in mainland China, with 30 more under development. The company’s focus includes cardiovascular and infectious diseases, dermatology, oncology, gynecology, and ophthalmology, among others.

“We are in a unique position to rapidly convert biomedical research into molecular diagnostic products for commercialization.”

-Dr. Lawrence Chi-Hung Tzang



Hong Kong Science Park Phase 3

One product that Lee's Pharm's researchers are excited about is Yalaferon®, a topical interferon. "Interferon is an effective antiviral agent produced by our own bodies but, being a protein, is unstable outside of the body," explains Dr. Benjamin Xiao-Yi Li, CEO of Lee's Pharm. "Our technology allows the protein to be stable at temperatures up to 20°C, suitable for topical application. Clinical studies have indicated its successful use for genital herpes, genital wart, herpes zoster, and cervicitis. A recent study showed eradication of high-risk HPV infection in some patients. Since HPV infection can lead to cervical cancer and has become an important women's health issue in China, we are participating in a study conducted by the Chinese Ministry of Health to advance HPV prevention and treatment."



Benjamin Xiao-Yi Li

Another promising treatment is the anti-platelet drug, Anfibatide, which has been 14 years in development. "It is a glycoprotein 1b antagonist with much lower bleeding risk," explains Dr. Li. "This is particular relevant in China because our diet makes native Chinese more prone to bleeding. Anfibatide is the first product with a novel mechanism of action to be advanced to phase 2 clinical studies." Currently, the drug is being tested for treatment of acute ischemic cardiac syndrome, with results expected by late 2013.

High-quality research and development has led to Lee's Pharm being ranked second in the "Best Small-Cap Company in China" ratings by Finance Asia and to be included on the Forbes Asia's 200 Best Under A Billion companies list.

"Hong Kong has easy access to [the Chinese and Japanese] markets... and is a good location for partnerships with key opinion leaders from the region."

-Mr. Paul Young

Hologic, Inc. www.hologic.com

Hologic, known as "The Women's Health Company," concentrates solely on women's health care needs including osteoporosis assessment, HPV testing, fetal fibronectin tests, breast magnetic resonance imaging solutions, and improved Pap Tests, among others. "The most important area for us is breast health—breast cancer screening, diagnosis, and treatment," explains Mr. Paul Young, Vice President of Hologic and General Manager of Asia Pacific. Hologic has created breast cancer screening products specifically for the Asian population through research collaborations with Hong Kong healthcare professionals.



Paul Young

While Hologic's world headquarters is in Boston, its Hong Kong branch in

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Hong Kong Science Park acts as its Asia headquarters. Hong Kong was chosen because it is the "closest to the biggest markets in Asia: China and Japan," explains Mr. Young. "It has easy access to both markets, provides easy shipping in and out of Asia, and is a good location for partnerships with key opinion leaders from the region."

After careful consideration, Hologic chose Hong Kong Science Park for both its facilities and accessibility to other countries. "Also, there are many similar companies in the Park that we can talk to, making it easy to find commercial partners," says Mr. Young.

Hologic plans to expand into other areas, including men's health by forming key partnerships with universities in both China and Hong Kong. "We work with universities and university hospitals directly because they are our customers," explains Mr. Young. "And with the Chinese Society of Radiology on education in breast cancer screening and diagnosis." Now with over 800 employees, Hologic's growth in China has been over twenty percent per year, an indication that Hong Kong is the perfect base for their operations.

PuraPharm www.purapharm.com

PuraPharm, a pioneering company dedicated to the internationalization and modernization of traditional Chinese medicine (TCM), was founded in 1998. With an investment of over HK\$200 million (USD\$26 million) in its state-of-the-art TCM research and production facilities in China's Guangxi province, PuraPharm is today a frontrunner in the industry. Their ISO-17025 (CNAS certified) in-house laboratory is regarded as one of the best TCM manufacturing facilities in Asia.

"It is very exciting to see how Chinese medicine is developing in China," says Mr. Abraham Yu-Ling Chan, PuraPharm's chairman. "Over the past decade, Hong Kong has not been leveraging its knowledge resources to modernize Chinese medicine. But in the next five years I believe we will see a big change, as TCM is becoming very popular here. Hong Kong is a very successful medical hub. It has credibility, attracts international scientists, and the work done here is of an international standard."

PuraPharm's main business supplies around 400 hospitals in China. The company produces concentrated TCM granules in sachets from prescriptions by professional practitioners. "It's not just modernizing TCM to add convenience," says Mr. Chan. "The granulation process allows us to standardize the treatments and test for heavy metals, making them safer." Crucially, PuraPharm is the only foreign-funded enterprise among six so-called Pilot Manufacturers of Concentrated Chinese Medicine Granules selected by China's SFDA. It has also been the only Chinese medicinal granule supplier of the Hospital Authority of Hong Kong for the past seven consecutive years.

Introducing TCM via PuraPharm's granules to a Western audience is next. "We have to show them that it's safe, that we have a quality control process," says Mr. Chan. "The next step is to demonstrate the effect of these products by doing clinical trials." With this in store, PuraPharm will no doubt continue to grow.



Abraham Yu-Ling Chan

Hong Kong Trade Development Council

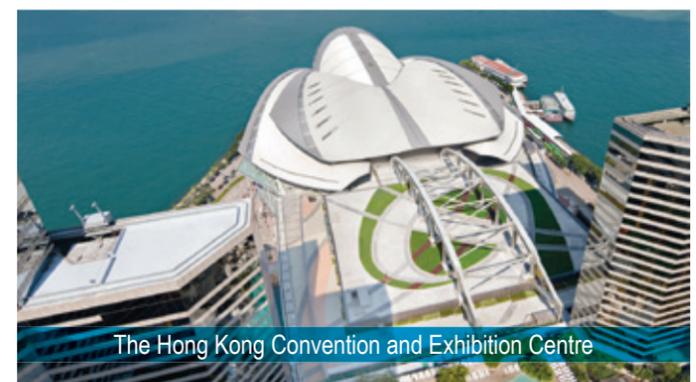
www.hktdc.com

The non-profit Hong Kong Trade Development Council (HKTDC) was established in 1966 as the international marketing arm for Hong Kong-based traders, manufacturers, and service providers. With over 40 global offices, including 11 on the Chinese mainland, HKTDC's mission is to create and promote business opportunities for Hong Kong worldwide.

"The major focus of our work is to organize the trade fairs in Hong Kong and to bring our Hong Kong companies to overseas markets," says Mr. Ralph Shui-Sang Chow, Director of Product Promotion. HKTDC attracts more than half a million buyers to

over 30 trade shows it holds annually. It features over 1.2 million registered buyers and 120,000 suppliers from Hong Kong, mainland China, and the rest of the world in its online marketplace, and publishes 15 product magazines with a readership of over five million. By organizing around 800 Hong Kong promotional events globally, reaching nearly 100,000 people each year, HKTDC also brings Hong Kong to the world. Six hundred international business missions visit Hong Kong a year with the assistance of HKTDC. Additionally, services such as HKTDC Business Matching help to connect companies who want to find the right partners.

Biotech is a key industry for Hong Kong and has been designated a "pillar of growth" by the government. HKTDC currently runs the annual Hong Kong International Medical Devices and Supplies Fair and receives biotech missions from myriad countries looking for collaboration. The organization also brings Hong Kong biotech companies to the rest of the world. Annually, it takes around 10 to 15 companies to the BIO International Convention, held in the United States. Last year, HKTDC also took biotech companies and organisations to Boston, calling on a medical school and the Massachusetts Institute of Technology to promote partnerships in biotech.



The Hong Kong Convention and Exhibition Centre

HKTDC's work related to biotech doesn't stop there. One anchor event for HKTDC is the Business of Intellectual Property Asia forum (BIP Asia), jointly organized by HKTDC and the Hong Kong Design Centre. "Biotech has the type of IP that needs a lot of legal protection and also financial services to facilitate its transaction," says Mr. Chow. "BIP Asia provides a platform to help all companies come together and facilitate the transaction."

Importantly for research and development in Hong Kong, HKTDC works closely with local R&D institutions to facilitate commercialisation of local innovation and technology by providing different outreach and marketing platforms. Mr. Chow explains: "We organize seminars and trade forums for them to publicize their latest achievements in the technology field, such as the ongoing series of Nanotechnology Forums co-organized with NAMI [the Nano and Advanced Materials Institute Limited] to promote their latest technology projects." To this end, Parker Robinson, the head of Corporate Communication at HKTDC, states that HKTDC also works closely with the Hong Kong Science and Technology Parks Corporation (HKSTPC). "Besides co-organizing promotional activities, we are keen to feature success stories of HKSTPC incubatees to highlight the capabilities and achievements of the local R&D sector," he says.

"We have very close working relationships at many different levels in China...we believe there is tremendous potential for further collaboration between Chinese and overseas companies."

-Mr. Ralph Shui-Sang Chow

have very close working relationships at many different levels in China," says Mr. Chow. "We have 11 offices in mainland China where our colleagues maintain contacts in every province. We also bring Hong Kong delegations to visit Chinese cities and carry out many promotional activities throughout the country to champion various technology sectors."

Chinese delegations visiting Hong Kong are also an important part of facilitating business. To many Chinese companies, Hong Kong is their springboard to the global market. "Almost weekly, Chinese delegations come to Hong Kong," explains Mr. Chow. "We organize promotional activities and seminars to help them reach their potential buyers and clients, and arrange networking functions and business matching services to connect them to the world." Mr. Chow continues, "Hong Kong also provides sophisticated professional legal, financing, and accounting services that facilitate Chinese-overseas investment partnerships." A case in point was a Chinese delegation brought from Jiangsu province to Los Angeles last year.

"We believe there is tremendous potential for further collaboration between Chinese and overseas companies," concludes Mr. Chow. "And Hong Kong plays a very important role as a facilitator and also as a platform for these buyers and sellers to conclude their negotiations."

Invest Hong Kong (InvestHK), a department of the Hong Kong SAR Government, is responsible for helping overseas and mainland Chinese businesses to set up and expand in Hong Kong. These businesses are from a broad range of industries, including biotechnology, which has been identified by the Government as a growth industry under the "Innovation and Technology" pillar.

"Our goal is to attract companies that bring new expertise to Hong Kong, so biotech is an important sub-sector for us," says Mr. Simon Galpin, director-general of Investment Promotion for InvestHK. "We have a lot of the world's biggest companies already very well established here. But we're keen to attract smaller, high-growth firms, including startups. Although these companies may only employ a few people at the outset, they need to use local service providers in Hong Kong. That in turn provides local job opportunities and has a spill-over effect."

Founded in 2000, InvestHK strives to promote Hong Kong as a world-renowned center for business and a place for strategic investment. InvestHK provides information for companies thinking about entering Hong Kong and relocation advice for expatriates, including housing, schooling, and more. InvestHK also helps with business development, facilitates introductions to contacts and service providers, and provides marketing and public relations for a company's launch and expansion. This year InvestHK will help over 300 companies set up and expand in Hong Kong.

One unbeatable advantage to conducting business in Asia's premier business city is Hong Kong's proximity to mainland China. Crucially, Mr.

Galpin is keen to emphasize the meaning of 'one country, two systems' in practice. "Why is Hong Kong unique?" he asks. "We explain those enduring advantages that haven't changed since the 1997 handover: Rule of law, low and stable taxes, free movement of information, availability of capital, and people."

"Second, we talk about the opportunities that arise or have arisen since Hong Kong reverted to Chinese rule," adds Mr. Galpin. "On the business-to-business side, the fact is that we have hundreds of mainland companies coming here who want to use Hong Kong to go global. Hong Kong is a meeting point."

A third advantage for biotech companies is that "we really are at the doorstep of the huge Chinese market. That is something that other competitors cannot challenge. They can't move their countries closer to China!" quips Mr. Galpin. "We sit next to the world's second biggest economy: if you are developing products that are ultimately going to be used in mainland China, it makes sense to be close to that market," he says. Hong Kong's location in the heart of Asia also makes countries like Japan, Korea, and all of South-East Asia easily accessible. Many of the continent's key markets are less than four hours' flight away and

half of the world's population is located within five hours' flight from Hong Kong.

A unique advantage for biotech in Hong Kong is its strong traditional Chinese medicine sector. "Hong Kong practitioners understand Chinese medicine very well and yet many of our practitioners have also studied Western medicine, so they are able to combine the Chinese and Western traditions together," explains Mr. Galpin. "I am certain that this will result in many breakthroughs in the coming years."

Beyond this, there are several other key advantages for companies setting up in Hong Kong. The city is a cosmopolitan one, able to attract talent worldwide to work and study. It has world-renowned universities that create top-level research and produce some of the best graduates globally. Businesses can draw also on talent from mainland China.

Mr. Galpin's advice for companies thinking of locating to Hong Kong is, above all, to come and visit. "Come and see the facilities we have. Meet some of the companies already doing business and research here—it is a great way to understand the opportunities. And use our services as much as possible because they're all free, customized, and confidential," he says.



Simon Galpin

There are, of course, challenges, both in terms of attracting investment in biotech and encouraging small companies or startups to set up in Hong Kong. "People know Hong Kong as a leading financial center and there are many Fortune 500 companies here," explains Mr.

Galpin. "But smaller companies sometimes assume that this is a market that isn't for them. We see Hong Kong as the ideal starting point when foreign companies come into Asia, particularly those from North America and Europe. All you need is one Hong Kong dollar, one hour of your time, and one director. We'll help a company as long as it commits to having just one person in Hong Kong."



Hong Kong at night

The Hong Kong Applied Science and Technology Research Institute

The Hong Kong Applied Science and Technology Research Institute (ASTRI) was set up in 2000 funded primarily by the government run Innovation and Technology Commission (ITC). Its three-fold tasks are to perform research and development for transfer to industry for commercialization, to develop technical human resources, and to bring industry and university R&D assets together. The organization's overarching goal is to help stimulate growth of technology-based industry in Hong Kong, including the health care sector. To this end, ASTRI focuses on five technology areas: communications technologies, consumer electronics, integrated circuit design, materials and packaging technologies, and biomedical electronics. It currently has a workforce of over 500 people, has close to 300 granted patents in China, the US, and other parts of the world, and has completed more than 300 cases



Francis Chee-Shuen Lee

of technology transfer in the form of technology licenses, research contracts, and more.

ASTRI's Bio-Medical Electronics (BME) team was formed three years ago to expand information and communication technologies into biomedical applications required by the

Hong Kong community and industry. "BME works by interacting with health care and medical professionals and users to ask how R&D might help enhance their professional practices and applications," explains Dr. Francis Chee-Shuen Lee, vice president and R&D director of the Bio-Medical Electronics Team. "Interacting with industry takes place through individual contacts, forums, and conferences. BME also interacts with academic organizations to explore linking applications based on their upstream scientific or engineering outputs."

In the near term, BME's core focus is in telecare, digital pathology, and traditional Chinese medicine. One specific project under way is the development of instrumentation and methodology for amblyopia ("lazy eye") treatment. "In China, three to five percent [of the population] has this problem, mostly children," says Dr. Lee. In the past, eye-patches have been the only means of training the patient's weak eye (a method only effective for children under nine years old). "But our method provides specifically defined visual hardware and application software," says Dr. Lee. "It includes careful evaluation and analysis of the condition of the patient's weak eye. Data show improvements in patients 10 years and older, even adults, using the training." Currently, BME is in the process of working with an industrial partner in China to commercialize the technology.

The Nano and Advanced Materials Institute Limited

The Nano and Advanced Materials Institute Limited (NAMI) was established in 2006 with government and industrial funds and has an annual budget of around US\$20 million. The organization's staff of 110 is located at the Hong Kong University of Science and Technology (HKUST) and the Hong Kong Science Park, with laboratories in both locations.

NAMI, the only nanotechnology center in Hong Kong, conducts market-driven, demand-led development of nanotechnology and advanced materials. Its primary goals are to develop nanotechnology, to act as a focal point for market-driven R&D, and to train human resources to meet the future needs of both Hong Kong and the Pearl River Delta region in mainland China. NAMI focuses on five market sectors: sustainable energy, construction/building materials, environmental technologies, display and solid-state lighting, as well as biotechnology and health care products. In addition to in-house R&D, it funds projects and collaborates with researchers at universities in Hong



Ka-Ming Ng

Kong and across the world.

NAMI has worked with academia to come up with important products, including oral capsules for the delivery of insulin and other biomolecules such as isoflavone, and engineering quality assurance solutions in the manufacture of Chinese herbal medicines.

"In biotech, one area that is important to us is Chinese herbal medicine," says Professor Ka-Ming Ng, CEO of NAMI and Chair Professor of Chemical and Biomolecular Engineering at HKUST. Another important project is a nanopreparation for the topical treatment of limb injuries. Local physicians have successfully used topical herbal pastes and patches to heal injured bones for hundreds of years. Research conducted by the Chinese University of Hong Kong, HKUST, and NAMI has identified key herbs that have healing effects through inflammation control, angiogenesis, and bone stimulation. A user-friendly patch developed to topically deliver the nanomized active ingredients has shown promising results.

"Products derived from biomaterials and related processing technologies ranging from biofuels to medical devices are expected to significantly impact our daily lives. NAMI is committed to contributing advances in this market sector," stresses Professor Ng.

City University of Hong Kong (CityU) is a dynamic higher education institution founded in 1984 that provides professional education and problem-driven research for the benefit of society. It has taken giant strides over the last few years and is now placed in the top 95 in the Quacquarelli Symonds (QS) World University Rankings 2012 and 12th in the QS Asian University Rankings 2012.

Well-known for its engineering program, which was ranked 32nd in the Academic Ranking of World Universities published by Shanghai Jiao Tong University in 2012, today the University is ramping up its life science and biotech presence, using its strong record of academic achievement as leverage.

"Globalized higher education in the 21st century will be characterized by role differentiation," CityU President Professor Way Kuo explains. "Each university should look for niche areas in order to impact higher education. With life science and biotech taking root in Hong Kong, and to leverage our existing profile of neuroscience research, CityU is expanding into veterinary medicine and biomedical engineering."

Among the top talents recently recruited to CityU's new biomedical engineering program is Professor Ying Li (see p. 1649) who joined the department in 2009 from the University of Michigan in the U.S. Ten other faculty members have been recruited lately from such institutions as the Massachusetts Institute of Technology and Princeton University.

A key factor in CityU's expansion into life science and biotechnology, and its ability to attract both professors and students from across the world, is its international outlook.

Professor Stella W. Pang

IEEE, AVS, and ESC Fellow, Chair Professor of Electronic Engineering, Department of Electronic Engineering



Stella W. Pang

A Hong Kong native, Professor Pang arrived at CityU in 2011 after two decades in the Department of Electrical Engineering and Computer Science at the University of Michigan. This July, Professor Pang, who completed her Ph.D. at Princeton, formed an interdisciplinary research team to explore health diagnostics, monitoring, and treatment using

Half of the faculty teaching the 20,000 students on campus are from overseas, and CityU aims to have 50 percent of its students spend at least one semester abroad at one of its many partner institutions, such as the University of California, Los Angeles, University of New South Wales in Australia, and Japan's Tohoku University.

In 2014, CityU hopes to launch a veterinary school in collaboration with Cornell University in the United States, with the objective of having the first American Veterinarian Medical Association-accredited veterinary program in Asia. The school will provide both undergraduate and postgraduate veterinary training, clinical training, and research into infectious diseases. It will address public health issues, the environment, and human-animal relationships.

With around 75 percent of human diseases—including severe acute respiratory syndrome (SARS) and avian influenza—originating in animals, Professor Kuo believes the new school will "add tremendous value to society."

Dr. Michael I. Kotlikoff, Dean of the College of Veterinary Medicine at Cornell, visited CityU in October for further discussions, agrees that food safety and food security are important issues in Hong Kong and mainland China.

Producing high-quality milk, for example, requires "not only equipment, investment, and cows, but also veterinarians," Dr. Kotlikoff says.

Crucially, Beijing's Tsinghua University will partner with CityU in developing the veterinary school's undergraduate program. The idea, Dr. Kotlikoff says, is to "train the trainers who will then go back and really impact the mainland."

Meanwhile, CityU's international outlook represents a perfect bridge between the East and West for its many innovative faculty members.

sensors and actuators. She hopes to build microsystems to target various diseases that, for example, could be related to hearing loss, eyesight loss, or Parkinson's disease. Research areas include nanofabrication technology, nanoimprinting, microfluidic systems for DNA analysis, nanostructures for cell growth, microelectromechanical systems (MEMS)-based chemical and biosensors, optical sensors for biomolecules, and micromachining technology and devices, among others.

CityU's strong reputation in engineering, combined with the university's focus on interdisciplinary work, is an advantage. "Being a young university allows us to explore different directions," she adds. "CityU is open to new ideas and wants to do something important and significant for society. I find that to be encouraging and attractive."

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Professor Paul Kim-Ho Chu

APS, AVS, IEEE, and HKIE Fellow, Chair Professor of Materials Engineering, Department of Physics and Materials Science



Paul Kim-Ho Chu

Professor Chu relocated to a new 500 m² laboratory three years ago, focusing on materials and plasma surface engineering research in CityU's Department of Physics and Materials Science. It is the only lab of its kind in Hong Kong. His diverse research activities span plasma science and engineering, ion implantation, surface modification, functional thin films, bio-materials, semiconductor materials

and processing, optoelectronic materials, and nanotechnology.

Professor Chu's innovative applied research and industrial applications in plasma processing and instrumentation have resulted in one European, seven Chinese, and 12 U.S. patents. Current research activities include an improved spinal correction rod. "Usually nickel in the rod will diffuse, causing allergies in the patient," explains Professor Chu. "We keep the mechanical properties of the original rod, but prevent nickel from leaching out by adding a protective coating." Following successful clinical trials, he is currently in talks with an industrial sponsor about licensing.

Hong Kong's proximity to China is an advantage, says Professor Chu, who just received 6.5 million RMB (US\$1.04 million) in research grants from China to develop biomedical products over the next five years. In total, he has been granted over US\$14 million in research funding from agencies and companies. Professor Chu is ranked number one in Hong Kong for research output—producing around 100 papers per year—and is in the top 100 worldwide in materials science according to Essential Science Indicators, based on the number of citations.

Professor Shuk-Han Cheng

Department of Biology and Chemistry



Shuk-Han Cheng

"CityU's environment is highly conducive to interdisciplinary research," says Professor Cheng, who joined the university in 1997. "I work with engineers or physicists so that I can produce things that I could never create on my own." While some universities separate disciplines into different buildings, CityU has disciplines such as biology and engineering based in the same place. "This means you interact more with your colleagues and can build up collaborations by getting to know the person. It is much more solid in terms of interaction and much more fulfilling," says Professor Cheng.

This trend in interdisciplinary collaboration has also extended to student interactions. Three CityU students from mechanical engineering, marketing, and accounting backgrounds have recently won international business competitions based on a CityU student's doctoral research, and now boast multinational companies among their startup's clientele.

Professor Cheng has also branched out into regenerative

biology through her interdisciplinary work. Pioneering research includes looking into the role of Iroquois genes in vertebrate retinogenesis and cardiogenesis.

Professor Ying Li

M.D. (Beijing), FAGA (U.S.), Department of Biology and Chemistry



Ying Li

Chinese-born Professor Li was educated at Beijing Medical University before becoming a general surgeon and oral-maxillofacial surgeon at Nanjing Medical School in China. He joined CityU in 2009 after two decades at the Department of Internal Medicine at the University of Michigan as an associate research professor. He has received over US\$3.8 million in research grants from the National Institute of Neurological Disorders and Stroke in the U.S. His research interests include brain targets for chronic pain, central nervous system sensitization and plasticity, sensory signal transduction in the vagal primary afferent neurons, and vagus nerve stimulation therapy.

"CityU supports neuroscience very well," says Professor Li, who currently has laboratories on the CityU central campus and the southern city of Shenzhen in the Chinese mainland. "What we're doing is unique, as very few laboratories are investigating brain cortex synaptic plasticity and vagal afferent neural control of chronic pain using an in vivo model."

Professor Wen-Jung Li

Department of Mechanical and Biomedical Engineering



Wen-Jung Li

Professor Li completed his Ph.D. in aerospace engineering at the University of California, Los Angeles, and worked at The Chinese University of Hong Kong for more than a decade before joining CityU last year. His research interests range from MEMS sensors to nanobiotechnology and electrokinetic nano-assembly.

"MEMS/nano-based biotech research in Hong Kong is expanding," says Professor Li. "In the early 2000's, only a few research groups in Hong Kong were focused on using MEMS technology for developing motion-sensing technologies and microfluidic systems. In the past five years, based on the proposals funded by the Hong Kong Research Grants Council, many research groups in Hong Kong are now working on lab-on-a-chip technology—which combines MEMS and biomolecular detection technologies—for chemical or biological detection."

Professor Li's group also makes advances in micropower generators, microcell grippers, and carbon nanotube sensors. They have received worldwide recognition based on a number of citations and awards from flagship IEEE international conferences. Professor Li's current research using optically induced electrokinetics as a possible technology to biologically mark cancer cells has recently received a joint Croucher Foundation-Chinese Academy of Sciences grant.

The Hong Kong Polytechnic University (PolyU) is a pioneer in application-orientated education and research within Hong Kong. Granted full university status in 1994, PolyU is today the territory's largest government-funded tertiary institution in terms of student headcount, serving the practical needs of both the local community and the wider world. Demonstrating innovation, as of mid-2011, PolyU had over 300 patents granted and 520 pending.



Chi-Ho To

PolyU is actively engaged in two biotech Areas of Excellence (AoEs), supported by the University Grants Committee (UGC) to spearhead development in research areas where Hong Kong competes internationally. It has been awarded funding for research in Chinese Medicine and Further Development as well as for the support of its Institute of Molecular Technology for Drug Discovery and Synthesis.

Areas of strength at PolyU include traditional Chinese medicine (TCM) modernization, food safety, myopia research, and biomedical ultrasound. One high-profile drug discovery project is the development of a new cancer drug that starves tumor cells through the depletion of arginine (a key nutrient for many cancer cells) and is showing great promise in clinical trials. On the food safety side, a demand for modern testing facilities led to the establishment of the Food Safety and Technology Research Center, hosted by the Department of Applied Biology and Chemical Technol-

Food Safety Technology

The Food Safety and Technology Research Center, hosted by the Department of Applied Biology and Chemical Technology, has won several awards for its work in improving food safety in Hong Kong. Dr. Ka-Hing Wong and Professor Samuel Chun-Lap Lo of the Department of Applied Biology and Chemical Technology, and Dr. Derek Siu-Wing Or of the Department of Electrical Engineering have all won Gold Awards in the International Exhibition of Inventions of Geneva. Professor Lo and Dr. Or's collaborative invention is a portable and fast device for rapid identification of food-borne microorganisms. Dr. Wong was also awarded the Young Investigator Award of the 2011 International Conference on Food Factors.



Mo Yang

ogy. According to the Food and Environmental Hygiene Department, in 2011 a total of 4,265 food complaints were handled—an increase of 14 percent over 2010. Researchers at PolyU are working hard to develop more sensitive and rapid food pathogen detection methods, assays, and devices.

Hong Kong has also grown into an excellent location for myopia research. "Here, patients are often very motivated and well-educated, so they are more willing to join clinical studies and try alternative methods to control myopia," explains Professor Chi-Ho To, associate head of the School of Optometry.

In an application-oriented higher education institute, which prides itself on research and innovation, collaboration and understanding are key. "The relationship between Hong Kong and China is growing," explains Professor Thomas Yun-Chung Leung from the Department of Applied Biology and Chemical Technology and Director of the Lo Ka Chung Centre for Natural Anti-Cancer Drug Development. "There are more and more collaborations. We help them to train students and postdoctoral fellows, while they provide the funding, power, and infrastructure." Examples include the Hong Kong Scholars Program in which 50 top Chinese Ph.D. graduates work in Hong Kong (half of their salaries are financed by the mainland government), and the HK Ph.D. Fellowship Scheme, established by the Research Grants Council in 2009, which aims to attract the world's brightest students to study in Hong Kong and has many applications originating in China. PolyU is actively involved in both schemes.

"The global population is becoming progressively more myopic... It's no longer just a national or Asian problem."

-Professor Chi-Ho To

"Food Safety has been a major concern in Hong Kong, where most of the fresh food is exported from mainland China. We cannot control the source, so contamination is a big concern," explains Dr. Mo Yang, associate professor in the Interdisciplinary Division of Biomedical Engineering and a core member of the Food Safety and Technology Research Center, the first of its kind run by a higher education institution. The Center aims to raise the standards of food safety by providing research, consultancy, and training services to food industries in Hong Kong and the Pearl River Delta Region.

PolyU focuses on both developing devices and promoting food safety knowledge that can be used by the government, public, and the catering industry. This year, PolyU hosted the annual 2012 Functional Food Symposium (functional food, explains Professor Lo, refers to "food that



Samuel Chun-Lap Lo

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has ingredients with specific functions that prevent diseases").

Professor Kwok-Yin Wong, Chair of Chemical Technology and Dean of the Faculty of Applied Science and Textiles, researches fluorescent biosensors and electrochemistry. His work includes the use of environment-sensitive dyes in the construction of protein-based biosensors. "Instead of using really expensive instruments to detect food contamination, we work to prepare agents that register unwanted contaminants by means of biosensors," explains Professor Wong. "These are ideal for on-site food safety inspections at the front line of quality control. We can bring [the testing device] in a briefcase. By contrast a full food safety lab is very expensive."



Wing-Tak Wong

For students of food safety, the advantages of studying at PolyU are plentiful. "We provide opportunities to place our students in the field, actually on site," points out Wing-Tak Wong, Director of Food Safety and Technology Research Centre, Department of Applied Biology and Chemical Technology. "Some of our arrangements are in China, particularly with government establishments. Students can help serve as ambassadors between China and Hong Kong, improving two-way communication."

"Food safety testing and related research is now expanding in Hong Kong," adds Dr. Yang. "There is a big demand for portable and rapid food safety screening devices." Dr. Yang has developed a sensitive nanobiosensor device that can detect pathogen contamination at only 10 colony forming units per milliliter, within 30 minutes. He is also developing organic polymer/semiconductor-based field effect transistors (bio-FETs) for food pathogen detection. "The bio-FET is a promising approach for label-free, rapid, and direct detection of biological targets. It directly measures the conductance change when food pathogens bind to the detector surface," he explains.

The Nature and Nurture of Myopia

PolyU's Center for Myopia Research was established in 1998 as an area of strategic development that later became a Niche Area of Research, with total funding of HK\$34 million (US\$4.4 million).

"The global population is becoming progressively more myopic, possibly because of the extensive amount of close work that we do. It's no longer just a national or Asian problem—it is becoming a world problem," explains Professor Chi-Ho To, associate head of the School of Optometry. "Although Myopia research is a PolyU niche area, we break boundaries; we involve microbiologists, geneticists, protein researchers, and physiologists," he adds. "It is really a translational and interdisciplinary research area."

Professor To's team works on the biological and optical signals that regulate normal and myopic eye growth. They study the growth signals

in the eye during development "using proteomics approaches in which thousands of proteins can be visualized and compared," says Professor To. "My lab has also demonstrated for the first time that the retina is capable of simultaneously integrating out-of-focus (defocus) images both in front of, and behind, the retina and guiding eye growth accordingly. This is an important finding in that it opens up a new opportunity to control myopia by manipulating optical inputs." Professor To and colleagues have carried out a randomized clinical trial on myopia control using a novel contact lens called a defocus-incorporated soft contact (DISC) lens and have found that myopia progression can be retarded by 50 percent using this device. They are now optimizing the treatment by enhancing the dosage of anti-myopia optics.

Professor Shea-Ping Yip, associate head (Research) of the Department of Health Technology and Informatics, is looking at myopia from a genetics viewpoint. In Hong Kong, "the proportion of the population undergoing myopic degeneration, which can cause severe vision loss and even blindness, is going to be quite high," says Professor Yip, who completed his Ph.D. in Human Genetics at the University College London.

He has collaborated with other international researchers in the Consortium of Refractive Error and Myopia (CREAM). "When I first started working in this area, there were only a few groups studying the genetics of myopia—now there are up to 40 groups in CREAM collecting

data," he says. "The trend is to look for genes and environmental factors that make us more likely to have myopia. We take a strongly multidisciplinary approach and join forces with scientists in other disciplines to solve common problems."

"Instead of using really expensive instruments to detect food contamination, we work to prepare agents that register unwanted contaminants using biosensors."

-Professor Kwok-Yin Wong

Biomedical Ultrasound

"Ultrasound research in PolyU has been expanding dramatically, in the development of new technologies as well as in using ultrasound to study a variety of research questions," says Professor Yong-Ping Zheng, acting head of the Interdisciplinary Division of Biomedical Engineering. "My team has made advances in a number of areas in biomedical and rehabilitative ultrasound, with a focus on the development of novel techniques for the assessment of soft tissues, including elasticity measurement, 3-D ultrasound imaging, and functional assessment of muscle, and their application through collaboration with researchers in different fields."

Professor Zheng's research and development in soft tissue characterization and elasticity measurement is internationally known, particularly for the team's novel patented techniques of ultrasound indentation, water-jet indentation, and air-jet indentation.

One especially interesting new technique developed recently is the radiation-free assessment of scoliosis using 3-D ultrasound imaging, trademarked as Scolioscan. Previously, children with scoliosis could not be adequately screened or monitored for the progression and outcome of treatment as X-ray imaging created a radiation hazard. But with the new technique, developed based on PolyU's pioneering research in musculoskeletal 3-D ultrasound imaging, they can be assessed frequently. A local company has licensed three related patents

from PolyU. Developed with a matching grant for commercialization purposes supported by the Government's Innovation and Technology Fund (ITF), a prototype is now ready for testing and clinical trials. The system not only generates an X-ray-like projected image for quick assessment, but also a 3-D virtual model of the spine in order to assess deformities in different visual planes.

The Scolioscan technology is important in Hong Kong—over three percent of children there are known to have scoliosis—and also globally. Professor Zheng suspects that more scoliosis sufferers will be diagnosed as more are screened using the new technique.

Another novel ultrasound technique for quantitative dynamic assessment of muscle function is called sonomyography and measures real-time changes in muscle architectural parameters. It can also be used as a human-machine interface, for example for the control of a prosthesis. Professor Zheng coined the term in 2006 and has since been awarded a U.S. patent. "In addition to its application, this breakthrough has also triggered the need for the development of new processing algorithms for muscle ultrasound images, and new ultrasound probes and systems, leading to the development of a new

field. I believe that sonomyography is changing the field of muscle functional assessment," says Professor Zheng.

In addition to Professor Zheng's team, PolyU has others colleagues working on different aspects of biomedical ultrasound across a number of different departments.

Cancer Drugs

"Research in cancer therapy shows signs of expansion in Hong Kong... and at PolyU," say Professor Thomas Yun-Chung Leung and Associate Professor Thomas Wai-Hung Lo, both from the Department of Applied Biology and Chemical Technology and Lo Ka Chung Centre for Natural Anti-Cancer Drug Development. PolyU is researching anti-cancer



therapies, either protein drugs or natural products, together with Professor Larry Chow, associate head of the Department of Applied Biology and Chemical Technology. "We are using compounds derived from herbs, traditional Chinese medicines, and enzymes from humans or even bacteria. Most anti-cancer drugs are very toxic with a lot of side effects; we hope these compounds will be safer as well as more effective," explains Professor Leung.

Professor Leung and Dr. Lo developed pegylated recombinant human arginase (named BCT-100) in collaboration with Dr. Paul Ning-Man Cheng of Bio-Cancer Treatment International, Ltd. (BCT, a local biotech startup company, see p. 1643). The research was based on work suggesting that arginine depletion can starve tumor cells to death whilst leaving healthy cells relatively unscathed.

"We saw the potential of developing a cancer treatment that is free of many of the deleterious side effects commonly associated with cancer chemotherapy," explain Professor Leung and Dr. Lo. "The main constituent of this new drug is human arginase, an enzyme that degrades arginine." Modification of arginase by adding polyethylene glycol has been found to greatly prolong the enzyme's activity in the patient's blood.

"From the bench to the bedside: translational research is what we are doing here."

-Professor Thomas Yun-Chung Leung

Following highly optimistic preclinical results, BCT has put the new drug in phase 1 clinical trials in Hong Kong for liver cancer, with phase 2 currently ongoing. Recently, BCT-100 became Hong Kong's first ever drug to receive investigational new drug (IND) approval from the U.S. Food and Drug Administration (FDA) and thus clearing the way for clinical trials in the United States. This achievement is an important milestone in the development of the biotechnology and pharmaceutical industry in Hong Kong. Since then Professor Leung and Dr. Lo have developed a second generation anti-cancer drug molecule named BCA-PEG20, which has also shown promising results in preclinical tests.

"We believe that we have actually found a universal way of treating cancer. It's not only effective against liver cancer, but against many other types we have tested as well," says Professor Leung. "Cancer drug development is a global challenge," he adds, "and it takes on average around 14 years to get a drug to market. We believe that knowledge transfer is important for drug development—from the bench to the bedside: translational research is what we are doing here."



Thomas Yun-Chung Leung



Thomas Wai-Hung Lo

Hong Kong Baptist University

www.hkbu.edu.hk

Established in 1956, Hong Kong Baptist University (HKBU) has over half a century of experience educating Hong Kong's top students and is today ranked 111th worldwide by the 2010 Times Higher Education World University Rankings. Research is a top priority at HKBU: a University Grants Committee (UGC) Research Assessment Exercise, released in 2006, showed that three out of every four full-time HKBU academics were actively engaged in research. Particularly noteworthy is the School of Chinese Medicine (SCM), the first UGC-funded institution to provide full-time higher education in Chinese medicine in Hong Kong, and in which all staff members are involved in academic research. The school, founded in 1998 with a strong focus on education, has a clinical division and a total of 400 students (about 20 percent of whom are from mainland China).

HKBU's small size is an advantage says Professor Chris Kong-Chu Wong, head of the Department for Biology. "Less is more," he explains. "Our university is small, so teacher-student interaction is closer compared to other bigger universities. All final year students are actively involved in research, which is very different from other local universities. Different disciplines in the university also join together to share resources, another significant advantage."

Collaborations do not stop there. Hong Kong sits in a unique position, with roots in both the Chinese and Western worlds. This makes it the perfect place to blend Chinese and Western medicinal practice and research. Crucial for HKBU's prestigious SCM are collaborations

with other top universities across the world. Of particular importance is HKBU's close work with mainland China. "There is more space in China and better connections for the industry; manpower is cheaper and we can obtain grant money there," says Raymond Wai-yeung Wong, HKBU's chair professor and associate head of the Department of Chemistry.

In February 2012, HKBU officially opened the Shenzhen Research Centre at the Shenzhen Virtual University Park in southern China with the aim of modernizing traditional Chinese medicine (TCM) and promoting research on materials science. Multidisciplinary research is at the new center's core, with researchers working together who hail from chemistry, biology, physics, and Chinese medicine backgrounds.

In March 2010, the Hong Kong Chinese Medicine Authentication Centre (HKCMAC) was opened, accompanied by the set up of A-Mark Quality Chinese Medicines Authentication Scheme—a mechanism

"There is more space in China and better connections for the industry; manpower is cheaper and we can obtain grant money there."

-Professor Raymond Wai-yeung Wong

to ensure the safety and quality of Chinese medicine products through a series of stringent laboratory tests. Its aim, backed by the Hong Kong government, is to promote Chinese medicine products in

the international market and boost consumer confidence in this age-old tradition under rigorous new testing. Overall HKBU's SCM, the largest in Hong Kong, is proving to be an invaluable research center and resource for biotech in Hong Kong.

The School of Chinese Medicine (SCM)

scm.hkbu.edu.hk

Professor Ai-Ping Lu

Dean of Chinese Medicine, SCM; Director of Institute for Advancing Translational Medicine in Bone & Joint Diseases



Ai-Ping Lu

a combination of Chinese and Western medicine," adds Professor Lu, who is a leader in international translational medicine and received his Master's and Ph.D. degrees from the China Academy of Traditional

Chinese Medicine (now known as the China Academy of Chinese Medical Sciences).

As a former director of the Chinese Academy of Social Sciences, Professor Lu believes that there "should be cooperation between Hong Kong and mainland China." This is particularly crucial in traditional Chinese medicine. China not only provides funding and resources but plentiful patients for clinical trials in TCM. Professor Lu has worked with Peking University and the Kunshan government to establish the Academician Chen Xinzi Translational Medicine in Bone & Joint Diseases Studio in the Kunshan Small Nucleic Acid Biotechnology Research Institute, which will promote RNAi-based translational medicine research in bone and joint diseases, funded by one million RMB per year (US\$160,182). In particular, the studio will develop a state-of-the-art platform to modify herbal products using small nucleic acid biotechnology to produce smart therapeutic molecules.

Professor Lu has also completed clinical trials for classical anti-arthritis drugs combined with natural herbal products designed to combat

rheumatoid arthritis. Trials conducted in mainland China have provided evidence-based methods to establish an ideal therapeutic strategy with a traditional Chinese style for sub-typed rheumatoid arthritis. Lu has been invited by Guanghua Hospital in Shanghai to establish the Institute of Arthritis to collect human samples from rheumatic patients, forming the largest biobank of rheumatoid arthritis in the world. "I am looking for further close cooperation [with China] in the construction of a translational medicine hospital in the next five or 10 years," he says.

Professor Zhao-Xiang Bian

Associate Dean and Professor of the Clinical Division, SCM



Zhao-Xiang Bian

Professor Bian's research focuses on three areas: the standardisation of Chinese medicine, new drug development based on TCM theory, and integrating Chinese medicine and Western medicine. Key for Professor Bian is his work helping to establish CONSORT (Consolidated Standards Of Reporting Trials) for TCM, which promotes the development of reporting standards and of design quality

for randomized controlled trials utilizing TCM.

TCM drug development is an exciting frontier. Using a strategy of integrating clinical testing with systems biology approaches, research teams are currently screening active compounds or active fractions from Chinese medicinal plants in specific target areas involving inflammation, cancer, viral disease, and diabetes to determine if small molecule drugs can be developed. "A fast track for new drug development can be created encompassing classical formulations and modern drug development paradigms," says Professor Bian. His team argued in a 2011 review published in *Acta Pharmaceutica Sinica* that the annals of Chinese medicine, which has treated patients for thousands of years, can be used as a rich resource for discovering new drugs. Beyond this, they offer centuries of patient data that are not yet being utilized and can help to bring safe, effective new drugs to the market in a cheap and rapid fashion.



"We try to **integrate** medicines to produce a **combination** of Chinese and Western medicine."

-Professor Ai-Ping Lu

of current treatments for certain diseases, such as cancer and metabolic diseases. The case for the merits of classical wisdom continues to strengthen," says Professor Bian. One example is the Hemp Seed Pill (a classical Chinese herbal medicine) for functional constipation. A paper published last year in the *American Journal of Gastroenterology* by Professor Bian's team concludes that this treatment is both safe and effective for alleviating excessive constipation. "Hong Kong is a very good place for integrative medicine development," Professor Bian concludes. "International teams can develop Chinese medicine here to help create new medicines."

"Worldwide, more and more people are interested in **Chinese** medicine. The use of **herbal** medicine is becoming more popular."

-Professor Zhong-Zhen Zhao

Professor Zhong-Zhen Zhao

Associate Dean and Professor of the Teaching Division

Professor Zhao is an internationally renowned scholar of Chinese medicine. For 30 years, Professor Zhao has focused his research on pharmacognosy and the authentication of Chinese medicine. In 2010, his "Encyclopedia of Medicinal Plants" was awarded a national prize of outstanding publishing, the highest government award in the news and publication field.



Zhong-Zhen Zhao

"Worldwide, more and more people are interested in Chinese medicine. The use of herbal medicine is becoming more popular," explains Professor Zhao. "At the same time, however, the quality of the herbs is also raising international concern. How we ensure the safety of medications is very important." In view of this, HKBU has established a standard authentication procedure which has been recognised by the international community.

Key is the creation of a database of herbal medicines (including a specimen center of authenticated herbal medicine and a museum of Chinese medicine) and a quality control platform for herbal medicines which have both been founded at the SCM in HKBU. Routine and innovative morphological authentication techniques have been used to authenticate herbal medicines.

"Hong Kong is a bridge to mainland China and to the rest of the world," says Professor Zhao. "It is also the window to show Chinese medicine to international society."

Integrative medicine is a new trend of our era. "Mounting evidence supports the idea that integrating classical wisdom from TCM with Western medicine can improve the effectiveness and/or safety

The Faculty of Science

Professor Ricky Ngok-Shun Wong

Acting Associate Vice-President and Associate Dean of the Faculty of Science
biol.hkbu.edu.hk/?page_id=802



Ricky Ngok-Shun Wong

Originally a biochemist, Professor Wong believes that "interdisciplinary research is very important right now." Professor Wong received his Ph.D. from the University of Oklahoma Health Sciences Center in Oklahoma City, U.S. and has experience in the biotechnology industry. He is responsible for setting up the biotechnology concentration of the applied biology program at HKBU.

In 1998, Professor Wong started his current research on the molecular pharmacology of ginseng, particularly the pharmacologically active ingredients, ginsenosides, and their effect on microRNA expression and biogenesis leading to angiomodulation.

"We discovered that the two types of ginsenosides: protopanaxatriols (PPTs) and protopanaxadiols (PPDs), possess opposing effects on angiogenesis," he explains, proving that ginseng is an adaptogen. Since this discovery, Professor Wong has addressed different ginseng-mediated activities in various models including angiogenesis, tumors, wound healing, anti-aging, adipogenesis, diabetes, and influenza.

A paper co-authored by Professor Wong in *Chinese Medicine*, entitled "Pharmacogenomics and the Yin/Yang actions of ginseng: anti-tumor, angiomodulating and steroid-like activities of ginsenosides" is today still the most accessed article for the journal with over 30,000 downloads since online publication in 2007.

Professor Raymond Wai-Yeung Wong

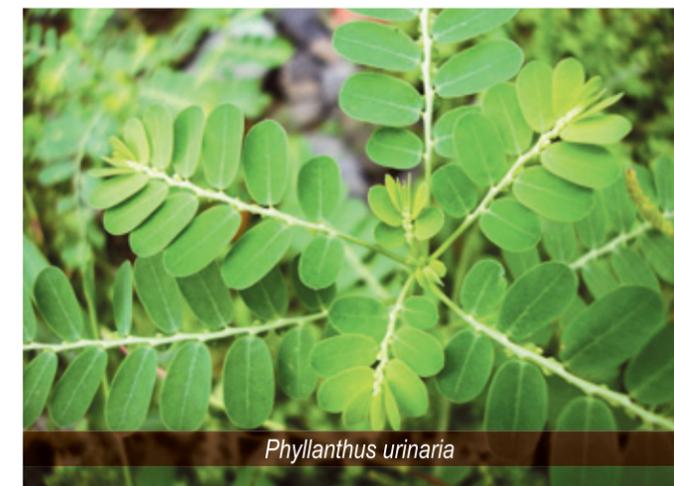
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Raymond Wai-Yeung Wong

Trained as a chemist, Professor Wong previously worked in traditional synthetic chemistry. Today, Professor Wong looks into basic scientific research and applications of new molecular functional materials with photofunctional and bio-imaging capabilities. He has a keen interest in investigating the potential applications of novel organic and metal-organic compounds in treating both solid and

non-solid tumors as well as hematological diseases such as platelet disorders and thalassaemia. He is also interested in drug discovery and drug delivery, especially bifunctional molecules able to both target a malignant cell and kill it. Of importance are his collaborations with the Research Development Division from the School of Chinese Medicine at HKBU to make use of *Phyllanthus urinaria* extract as an antidote for hepatotoxicity after overdose administration of Panadol (acetaminophen). The collaborative team has shown that *P. urinaria* extract works well in animal models and is now working with a Hong Kong biotech-



Phyllanthus urinaria

nology company to conduct clinical trials in the medical school of a local university. "Such work is expected to provide promising lead compounds for new drug development, and in vivo tumor profiling and diagnosis using two-photon bio-imaging techniques," says Professor Wong.

Professor Chris Kong-Chu Wong

Director, Croucher Institute for Environmental Sciences
Head, Department of Biology
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Chris Kong-Chu Wong

Professor Chris Kong-Chu Wong specializes in environmental research. His current research interests include osmosensing mechanisms and osmoregulatory functions of fish gill cells, functional characterization of human glycoprotein hormones STC1 and STC2 in carcinogenesis, and environmental contamination and mechanistic actions of emerging chemical pollutants.

"We do environmental diagnostics," says Professor Wong, who has been working in the areas of endocrinology and toxicology for over a decade. He now focuses on how pollutants affect human growth and health.

"Ten years ago, we collected different kinds of environmental samples for the measurement of different environmental pollutants. We are now moving to the measurement of pollutants in human body fluids such as blood and urine samples." With respect to human disease, Wong's laboratory is focused on human infertility, metabolic disorders, and the correlation between blood levels of pollutants and the occurrence of systemic lupus erythematosus, an autoimmune disease. This shift to researching the effects of environmental pollution is new to Hong Kong. China poses its own pollution problems: high levels of mercury are found in both the effluent from coal-burning power plants and in cheap creams used to whiten the skin. "Following patients from exposure to disease development has a very long time lag," says Professor Wong. "We look for hidden susceptibilities that may be triggered, leading to metabolic disease." Professor Wong's research is aimed at understanding and combating the development of these disorders.

Academic Excellence

University of Hong Kong

www.hku.hk

The University of Hong Kong (HKU), located on Hong Kong island, was established in 1911 and is the city's oldest university. HKU sits at the top of the Hong Kong league tables, ranked 23rd globally according to the Quacquarelli Symonds World University Rankings 2012. HKU has the most Academicians of the Chinese Academy of Sciences of any local institution, and many of its scholars are amongst the top one percent in their field according to ISI's Essential Science Indicators.

Importantly for biotech, HKU's Clinical Trials Centre at the Li Ka Shing Faculty of Medicine was established in 1998 with the mission of enhancing global health care by attracting and facilitating clinical research on new drugs, medical devices, and other medical products, methods, and procedures, whilst ensuring compliance in terms of subject protection, scientific validity, and data integrity. HKU's Centre for Genomic Sciences, also part of the Li Ka Shing Faculty of Medicine, offers genomics, proteomics, and bioinformatics services. The center was established to facilitate the translation of knowledge into applications and is at the forefront of genomics research.

HKU's Technology Transfer Office helps those with inventions and patent applications to find funding and turn discoveries into business opportunities through licensing and commercialization.

Chinese University of Hong Kong

www.cuhk.edu.hk

The Chinese University of Hong Kong (CUHK) is located in the New Territories near the Hong Kong Science Park. Founded in 1963, CUHK is ranked 15th in Asia according to the Times Higher Education World University Rankings 2011–2012. It is renowned for its research in the sciences and has a top medical school, clinical trial center, Knowledge Transfer Office, and the affiliated Hong Kong Institute of Biotechnology offering downstream support to the industry. The University houses four state key laboratories in collaboration with

the Ministry of Science and Technology of China that produce research of national importance.

Professor Hsiang-Fu Kung, research professor of Virology at the Stanley Ho Center for Emerging Infectious Diseases and the School of Biomedical Sciences at CUHK, specializes in molecular genetics, molecular oncology, and virology. He looks at diseases such as human immunodeficiency virus, hepatitis B virus, and seasonal flu, and his diverse research interests include bacterial genetics and metabolism, enzymology, gene regulation, cytokines, and oncogenes. Infectious diseases are "always a major health problem in Hong Kong because of our special geographic location, the society, and the weather," explains Professor Kung.



Hsiang-Fu Kung

For Professor Kung, CUHK's proximity to mainland China is a huge advantage, as it has a multitude of patients with infectious diseases, says Professor Kung, a member of the Chinese Academy of Sciences and an honorary professor at Peking Union Medical College. "My laboratory has enjoyed excellent collaborations with scientists in mainland China. We have established a wonderful friendship and collaborated very successfully on many international projects," he adds.

Hong Kong University of Science and Technology

www.ust.hk

The Hong Kong University of Science and Technology (HKUST) was founded in 1991 and is currently ranked 62nd worldwide and 7th in Asia (Times Higher Education World University Rankings 2011–2012). HKUST's focus on Biological Sciences and Biotechnology, considered one of five high-impact areas, is exemplified by the marine science research of Professor Pei-Yuan Qian, founding director of the university's state-of-the-art marine laboratory.

Professor Qian, who is in the Division of Life Sciences, researches marine invertebrates. His research centers on the isolation and identification of non-toxic antifouling compounds and drug leads from marine organisms, the interaction between settling larvae and biofilm dynamics, larval 'omics, and microbial metagenomics.

"We are pioneers in several areas of larval biology research, such as larval 'omics," explains Professor Qian. "We are one of the world's leading labs in both the larval biology and biofouling/antifouling research, and the Environmental Science Program at HKUST is currently ranked 32nd in the world. Hong Kong itself has become a center of larval biology research."

Professor Qian directs a collaborative research project under the Global Collaborative Research Program of King Abdullah University of Science and Technology (KAUST) to study microbial metagenomics and bioactive compounds from the Red Sea. "We have many collaborations in mainland China," says Professor Qian. "If we were located in North America or Europe this wouldn't be possible. In Hong Kong we also enjoy academic freedom and an independent faculty."



Professor Pei-Yuan Qian (left) showing guests around his marine laboratory



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