

Foreign Members Offer Advice on Innovation at CAS and in China

During the session of the 16th General Assembly of the Chinese Academy of Sciences, Foreign CAS Members were invited to give advice on a series of issues, including the national plan to build an innovation-oriented country and promote homegrown innovation, the reform of Chinese R&D system, and the new strategy of CAS highlighting the importance of democracy, openness and talents. BCAS reporters, SONG Jianlan and XIN Ling, present the detail here.

Alfred Y. Cho: China Needs Its Own Bell Laboratories

In his speech at the opening ceremony Mr. HU Jintao emphasized the importance of homegrown innovation. Here I would like to share some opinions on this idea based on my 40-odd-year experience with the Bell Laboratories in the U.S.

Bell Laboratories (Bell, hereafter) made brilliant achievements at its peak, and was hence well recognized by Americans as the most advanced research laboratory in the world. Many milestone inventions, including transistors, the laser, solar cells, the multi-task operation system Unix, and satellites (Telstars) were contributed by Bell. During its golden age from the 1950s to the 1990s, Bell focused

on fundamental research with an annual funding of \$2 billion from AT&T, in the form of tax deduction from the government. Nowadays, however, Bell has lost this strong, steady financial support for fundamental research. Instead, it is now affiliated with the Alcatel-Lucent Ltd., and the latter funds its R&D activities in the form of commercial investments. As a for-profit company, Alcatel-Lucent attaches much importance to commercial benefits and requires Bell to make its R&D projects profitable in a short time. Therefore the present Bell's mission is to develop new products that will help Alcatel-Lucent to make money. Most of the projects are short-term (lasting three to five



Prof. Alfred Y. Cho

Prof. Alfred Y. Cho, a world-renowned scientist in semiconductor technology, currently serves as the Adjunct Vice President of Semiconductor Research at Alcatel-Lucent's Bell Laboratories. Cho is the recipient of IEEE Medal of Honor (1994), the National Medal of Science (1993), and the National Medal of Technology (2007), and Awardee of the National Inventors Hall of Fame. He is now a Member of the National Academy of Sciences and the National Academy of Engineering, as well as a Fellow of the American Physical Society, the Institute of Electrical and Electronics Engineers, and the American Academy of Arts and Sciences.



CAS President BAI Chunli (left) holding a talk with Prof. Cho in 2010.

years) that promise quick commercial returns and make Alcatel-Lucent having a competitive advantage over their competitors.

What differentiates the Bell at the golden age from the present one is the long-term support of fundamental research in physical science. Nevertheless, this long-term fundamental research, such as homegrown innovation will not bear fruits overnight; sometimes it is hard to predict whether it can become anything useful in two or three decades. Therefore if we aim to build up our own homegrown innovation, we must establish a research structure similar to what Bell adopted in its heydays to focus on original innovation experiments. China, with its strong economy, is financially powerful enough to support fundamental research without expecting short-term returns.

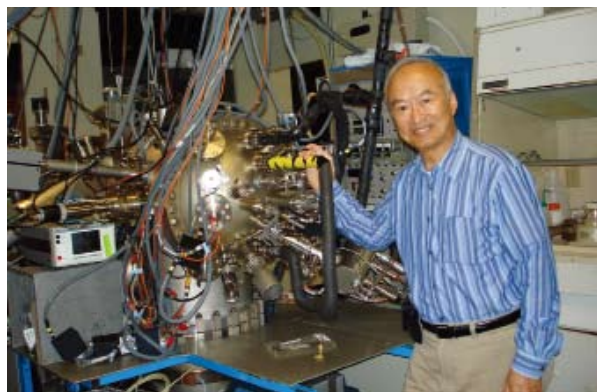
Truly it takes commitment and persistence to maintain such a laboratory. Yes, science and technology (S&T) should be connected to economic developments, and naturally good S&T competence leads to economic growth, but the incubation takes time. Probably no visible effect will appear in as long as 20 years or more. Therefore it takes vision and determination to create an environment for homegrown innovation.

One might ask why iPad achieved such a great success in just three to five years. You know iPad is different. It was developed by assembling many existing technologies to build a fashionable “toy” that people of young generations want. However, to make something out from scratch is totally another thing. What we need are exactly such things: innovations and inventions.

The structure of the Bell in the research heydays consists of 20% projects in fundamental research, 70% in applied research, and 10% in manufacturing research. Such

a structure combined both “top-down” and “bottom-up” strategies: Scientists would like to make free explorations out of their own interests, representing a bottom-up strategy and democracy, while managers would pay more attention to the connections between science and manufacture or the market, representing a top-down strategy. For basic research, applied research is actually its customer; for applied research, manufacture is its target customer; and for manufacture, the market is its ultimate goal. The managers at different levels of the hierarchy of Bell took charge of the orientation of the research, making sure that it contains both basic research and applied research that would finally join the chain of scientific transfer. In sharp contrast, nowadays what the Bell does are short-term projects, and meanwhile they need to do business to seek profits. Under such circumstances, it would be difficult to look down the road of 20 years and build up the homegrown invention and innovation.

I am very impressed by CAS President BAI Chunli’s new approach to run CAS, namely the trinity principles emphasizing democracy, openness and talents. Taking the definitions of A- and B-types of research proposed by Mr. BAI for example, Type A refers to applied research and manufacturing research, which account for 80% of the budget, and Type B fundamental research that accounts for 20% of the budget. This operation would be like the structure of the Bell in its heydays. What’s important is to have an environment that can support a long-term research with sufficient steady financial support. I have talked about democracy and openness of Bell’s R&D practice above; while regarding talents, we are very cautious when



In 2007 Prof. Cho was honored with the U.S. National Medal of Technology, the highest honor awarded by the President of the United States for technological innovation for his contributions to the invention of molecular beam epitaxy (MBE), a method of depositing single crystals in the late 1960s. Shown in the photo is the “Father of Molecular Beam Epitaxy” with his MBE machine.

employing a scientist or an engineer. We must make sure that we have the most intelligent scientists and engineers working for us. You need to get brave enough to recruit people who are more talented than you, rather than to guard them off in fears for their possibly replacing you someday. Only in this way can your company move forward. Remember, what makes a company great is the people in it. Therefore I would like to propose setting up a Bell-like trinity structure for scientific research in China; in so doing we will be able to fulfill Mr. HU's goal for homegrown innovation.

Coming to the election of CAS Members, I see that we

tend to elect people from our own field. I would like to see a wider spectrum of candidates from more diverse areas, to have a more complete set of membership to serve the need of the country. In order to attract the best people around the world to work in China, the funding should be increased. As far as I know, some scientists recruited through the "Hundred-Talent" Program and the "Thousand-Talent" Program are well funded for the equipment (platform) but poorly funded for the operation expenses. We need to make sure that they will remain in China after the five-year contract is up.

(Reported by SONG Jianlan)

Prof. Francois Mathey: On Roles of Scientists and Politicians, and Science Evaluation

What Mr. HU Jintao proposed is a very good innovation program, most of which could be adopted by many advanced countries. Scientists all over the world are facing some common problems, including the breeding of young talents. They are making progress in their respective areas, including new drug design and development, but it is not so easy for them to connect their research to the society. To some extent, they are not fully aware of the public needs. Political people can help define the applied targets of science, and scientists can find the solutions. Of course whether or not they can succeed in finding solutions to such issues is unknown.

The way to evaluate scientists in China gives too much weight on impact factors and citations. By definition original results are different and might not be cited. What can be detected by impact factors are fashionable subjects. Some "too original" work might not even be accepted by



Prof. Mathey at the reception for the China Friendship Award in 2009 in Beijing.

journals. Therefore better not to force but to push people to think differently.

(Reported by SONG Jianlan)



Prof. Francois Mathey

A renowned French scientist in organic chemistry, Prof. Mathey was elected Member of the French Academy of Science in 1998. Because of his outstanding contributions to training young researchers for China and promoting scientific collaborations between China and France, Prof. Mathey was granted the 2009 Friendship Award of the People's Republic of China. He was elected a Foreign Member of the Chinese Academy of Sciences in 2011.

Shu Chien: Science and Innovation for the People

President HU's speech at the opening ceremony of the General Assembly was inspiring. The six points of expectations expressed to the science and technology community clearly demonstrated how highly the national leaders think of the cause of S&T. His speech also shows that the country has put a great deal of emphasis on innovation. I believe the word "innovation" was mentioned in his speech at least 20 times. Innovation is of the utmost importance to S&T research. Studies that merely follow past research with little creativity will not exert much impact; what would make the difference is innovation.

President HU's speech also shows that the national government highly values the welfare and health of the people, as well as the sustainable development of the society and the economy. The country has provided a guideline for the science community and expressed direct expectations to the S&T workers, hoping them to commit themselves to their cause, to work for the welfare of the people, the prosperity of the society, and the long-term well-being of the nation. It is important to let the people feel the benefits of S&T development, the improvement of health level and life quality, and the continuous growth of the national economy.

To maintain a leading position in the face of intensive international competition, there is a great need to strive to make innovations, to pursue progress, to dedicate to excellence. All of us need to make great efforts to meet these goals. The whole speech is impressive, as it pointed out the direction for the S&T community. I am very pleased and inspired.



Prof. Chien receiving the National Medal of Science from US President Obama on Oct. 21, 2011.

China has made remarkable advancement in science and technology the last two decades. What needs some changes might be the reviewing system for science funding application. One possible consideration is to broaden the review body to include international experts. This would require the proposals to be written in English. In view of the increasing globalization of S&T and the nearly universal use of the English language in scientific publications and communication, the use of English language in proposal writing would also help the skill of writing scientific papers, thus having a double advantage.

To put the Foreign Members' role in full play, it may be worthwhile to have a column for the foreign membership in the two CAS journals, namely the *Science in China* and the *Chinese Science Bulletin*.

(Reported by SONG Jianlan)



Prof. Shu Chien

Prof. Chien is an eminent biological scientist and engineer. Because of his outstanding contributions to advancing knowledge in the inter-disciplinary research of biomedical sciences and engineering, Prof. Chien is one of the only six scholars who are members of all four U.S national institutes, that is, the National Academy of Sciences, National Academy of Engineering, the Institute of Medicine, and the American Academy of Arts and Sciences. Chien was elected to the Chinese Academy of Sciences in 2006. He is also the recipient of the United States National Medal of Science in 2011.

Muming Poo: Cultivating Native Talents in China

I think China is losing its most talented young people. The existing policies lack sufficient support to those young people who wish to stay in China for the career. Thus, the most talented college graduates and most successful new PhDs are leaving China for graduate studies or postdoctoral training abroad in the US and Europe, spending the most creative years of their lives abroad in foreign laboratories.

When they choose to come back under the current programs, the government is ready to give them attractive packages including high salary, start-up funds, and other benefits that are not available to those young scientists who choose to stay in China for their entire career. This is unfair to many outstanding domestic researchers who have never worked abroad. Meanwhile, preferential treatments to those from abroad

encourage further exodus of young talents, depleting the critical innovative population of young students and postdocs from the domestic laboratories. This is a vicious cycle.

China has reached the stage that cultivating native talents is more important than attracting scientists from abroad. There is an urgent need in correcting the biased policies in all of our research institutions. The recruitment programs for overseas scientists like the “Hundred Talents Program” and the “Thousand Talents Program” need to be supplemented with a parallel program of supporting young scientists who choose to stay in China for graduate studies and postdoctoral training. If domestic Chinese laboratories continue to be deprived of the best group of young people, they will be in a disadvantaged position in the competition with foreign laboratories.

(Reported by XIN Ling)



Prof. Muming Poo

Professor Muming Poo is a distinguished neurobiologist at UC Berkeley. He has been working as the founding director of the Shanghai-based Institute of Neuroscience, Chinese Academy of Sciences since 1999. He is successful not only in bringing China's neuroscience to the international level, but also in creating a favorable mechanism and culture for pursuing original discovery. Prof. Poo is a member of the US National Academy of Sciences, and was elected as a Foreign Member of the Chinese Academy of Sciences in 2011.

Prof. D. Roger J. Owen: Roles of Talents and Enterprises in Innovation

Innovation is crucial to the country's development. China is approaching the No. 1 economy in the world, and its science and technology is becoming increasingly stronger. At this point the nation needs a good innovation program to turn its S&T into economic benefits. To do that, the training of talents is very important, as their

professional development is essential to the translation of S&T into economic returns.

On the other hand, the role of enterprises should be fully respected. They should be given equal attention as scientific research. Entrepreneurs can work together with scientists to translate science into economy, and into



products that are useful to society. This is also the model upon which Western economic progress is based.

From China’s point of view, it is also essential that young researchers feel that they have a promising and rewarding future within the national scientific framework in order to diminish the drift towards emigration to the USA, Europe and elsewhere. To accomplish this it is necessary that young researchers, as well as working within a structured environment contributing to teamwork activities, should also be allowed to develop their own creative ideas.

(Reported by SONG Jianlan)



Prof. Owen receives the Koiter Medal of ASME in Washington DC in November 2003.



Prof. D. Roger J. Owen

Prof. Owen, a mechanics expert from the Swansea University’s College of Engineering was inducted as Fellow of the Royal Society in 2009 and Foreign Member by the United States National Academy of Engineering for his original contributions to computational solid mechanics and industrial application of finite and discrete element methods in 2011. For the same reason, he was elected to the Chinese Academy of Sciences in the same year.

Norman N. Li: A New Evaluation System May Help China Boost Innovation Process

I’ve heard many times that CAS and CAE are striving to enhance cooperation with other academies in other countries. I am a member of the US National Academy of Engineering (NAE). I had attended a meeting in Washington before I was here. At the meeting, many of my American colleagues at NAE knew I was coming to Beijing and asked me to bring along their wishes to enhance the relationship with scientists at CAE and CAS.

As for S&T innovation, first of all I think President HU Jintao’s speech at the opening ceremony was very much to the point. It was important and timely for today’s China. He emphasized the importance of innovation, in the context that today’s China is rising on the international arena not only as a manufacturing giant but also a major player in the new innovation era. The establishment of a

“national innovation system” fits in with this perspective.

The President mentioned that China needs to set up a scientific evaluation system to accelerate the innovation process. An evaluation system is absolutely necessary, and I’d like to offer some suggestions on the details of such a system based on my 40 plus years of working experience in the chemical and petroleum industries in the US. Recently, a best-practice innovation process in the US is called the “stage-gate” system. In a stage-gate system, the entire innovation process – from the birth of an innovative idea to the development of innovative products – is divided into different stages separated by gates. At each gate, there is a “gate-keeping” or steering committee to evaluate and decide the continuation of the process. The funding of the entire project is also divided and allocated to different

stages. In this way, the project has to pass every stage before entering the next one, and any unsuccessful projects will be terminated before they waste funding. Meanwhile, sitting on the steering committee are not only scientists but experienced managers from the financial, business, sales, strategic planning and engineering design as well as production sectors of a company. Personally I think such

a quality management technique is very effective and may provide an innovation solution with high efficiency for many research institutes and enterprises in China. My wife and I will be happy to help in the implementation of such a quality management system (my wife, Dr. Jane Li, is an expert on quality management).

(Reported by XIN Ling)



Prof. Norman N. L

Professor Norman N. Li is now Chairman and President of the NL Chemical Technology, Inc. He is a Chinese American engineer and scientist famous for his inventions and development of liquid membrane technologies, and was elected to the US National Academy of Engineering in 1990. He became a Foreign Member of the Chinese Academy of Sciences in 1998.

Tso-Ping Ma: Towards an Unbiased and Comprehensive Funding System

I've been coming back to China since 1995 and made many scientific exchanges with CAS institutes and Chinese universities. Recently I'm coming back more often, at least twice a year, because in 2010 I formed an enterprise in Beijing with support of the municipal government to commercialize a new type of memory chips. I'm very much impressed by the amazing progress of science and

technology in China over the past 20 years, but there are still issues I found that could be improved.

From my experience in applying for research funding in China, I found that the funding agencies in this country are usually government agencies, and they are in charge of organizing the evaluation committees for project proposal assessment. The evaluation committees are funded by



Prof. Tso-Ping Ma

Professor Tso-Ping Ma is the Raymond John Wean Professor of Electrical Engineering and Applied Physics with Yale University. Since 1980s he has supervised dozens of Chinese PhD candidates at Yale, and his research group has carried out collaborations with research institutions in China including the Chinese Academy of Sciences, Tsinghua University, Peking University and Shandong University. He became a Foreign Member of the Chinese Academy of Sciences in 2009.



the funding agency, implying an interest link between the committee and the agency. And most committees don't have a rotating membership: the experts are the same for years.

The investment in the R&D and commercialization sectors is still insufficient in China today. Many of China's basic research programs are world-leading now, but the development and transfer of technologies remain weak. To boost innovation means the government should pour more money to help translate new ideas into new technologies and products. When the cost is high and revenue is uncertain in the process of technology development, the government should come in and play a key role here. Besides, I hope

there will be some preferential policies for medium and small enterprises, as in China most of the R&D money flows to existing big companies rather than smaller, newer ones.

I have also observed that, although many policymakers are eager to increase spending on scientific facilities, they do not pay enough attention to the employment and training of people who are going to operate those expensive machines. The machines won't run by themselves; they need to be fully exploited by professional workers, or they'll be out of date in several years' time. So when funding the facilities, we must also adequately fund people.

(Reported by XIN Ling)

Lap-Chee Tsui: Talents Important to Innovation

China has improved a great deal since I first began to interact closely and collaborate with my counterparts in the Mainland two decades ago.

Concerning research publications, however, local scientists prefer foreign English journals to *Science in China*, and this is natural because the latter's reputation has yet to reach a top international level. CAS may consider publishing some joint issues with leading journals such as *PNAS* to elevate the status of *Science in China*.

CAS may wish to address the problem of plagiarism. For English articles, there are software programs, such as turnitin, which allow students to self-check their papers before they hand in their writing assignments, but it is not known if similar software is available for Chinese texts.

Professors tend to retain their own students to work in their institutions rather than sending them to other institutions upon graduation. This is not very good practice,

because it not only limits the growth and development of the students but may also slow down innovation of their institutions, which need new blood and renewal to stay competitive and sustainable.

The points covered by President HU's speech at the opening ceremony are rather pragmatic. For example, China has to invest in the nurturing of the next generation of talents in science because science and technology play an essential role in the nation's future development and prosperity. Currently, a top university graduate could find a very well paid job in the financial sector, whereas choosing to pursue scientific research may mean much less income. This social reality may have deterred many youngsters from pursuing a career in science. I hope the Government can remedy the situation and attract more talented students to choose a professional career path in scientific research.

(Reported by SONG Jianlan)



Prof. Lap-Chee Tsui

Prof. Lap-Chee Tsui, a genetics expert, currently serves as the Vice-Chancellor of the University of Hong Kong (HKU). He won international recognition in 1989 for his identification of the defective gene that causes cystic fibrosis, a major breakthrough in human genetics. He has also made significant contributions to the study of the human genome, especially the characterization of chromosome 7. Tsui is a Fellow of the Royal Society of Canada, the Royal Society of London, and Academia Sinica. He is also a Foreign Associate of the National Academy of Sciences of USA and a Laureate of the Canadian Medical Hall of Fame.