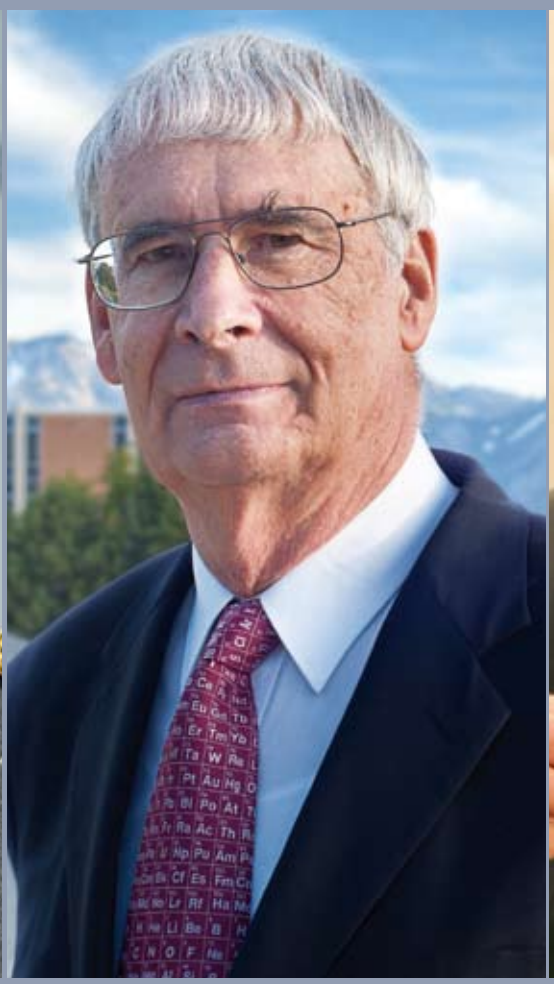
“Science Always Has Been, and Continues To Be International”



"Science always has been and continues to be international," said chemist Peter J. Stang, co-winner of China's International Science and Technology Cooperation Award this year, during an interview with *BCAS* in March, 2016.

His collaboration with China originated from a visit to the CAS Institute of Chemistry more than ten years ago. There, he discovered that "they had expertise that we did not have but would be very interesting to apply in our research". Today, this partnership has been expanded to all across China, from Beijing to Dalian, Shanghai and Hangzhou.

International collaboration has always been a major strategy in science and technology development in China, and its importance has remarkably increased in the 21st century. "The world is facing climate change, food security, public health and many other problems that ask for cooperation between nations," said Vice Premier LIU Yandong at the awarding ceremony of the cooperation award in January in Beijing.

"Science has no borders," she stressed. She revealed that the Chinese government will create more opportunities to encourage science cooperation, attract high-caliber overseas talents and create a better environment for their research career in China.

The same month, CAS also announced the winners of its 2015 Award for International Scientific Cooperation. Three scientists were recognized for their lasting efforts in promoting collaboration between CAS and their own countries. They are: combustion scientist Katharina Kohse-Hönghaus from Germany, climate researcher John Kutzbach from the US, and biologist John Roger Speakman from the UK.

In this issue of *BCAS*, our reporter XIN Ling has the privilege to invite Prof. Kohse, as well as Prof. Peter J. Stang and Prof. Jan-Christer Janson – last year's laureates of the CAS cooperation award – to talk about their collaboration history with Chinese scientists, share their insights into China's research status and prospect in their fields, and offer suggestions to young scientists in this country.

The CAS Award for International Scientific Cooperation honors foreign experts who have made outstanding contributions to international S&T cooperation, and encourages the world's top scientists to engage in long-term cooperation with CAS. Since its launch in 2007, the award has been given to a total of 25 foreign experts, over half of whom have also been recognized by the Chinese government with two of its highest awards in international cooperation: the Friendship Award, and China's International Science and Technology Cooperation Award. Prof. Peter J. Stang and Prof. Jan-Christer Janson are among this year's recipients of the International Science and Technology Cooperation Award conferred by Chinese President XI Jinping at the Great Hall of the People in Beijing.

Fostering Sino-German Partnership in Combustion Science

—— An interview with Prof. Katharina Kohse-Höinghaus

Prof. Katharina Kohse-Höinghaus. (By courtesy of Prof. Kohse)

Prof. Katharina Kohse-Hönghaus is a distinguished expert in combustion diagnostics, pioneer of novel experimental techniques of low temperature combustion, and leading scientist in biofuel combustion. Based at Bielefeld University, Germany, she also serves as a member of the National Academy of Sciences Leopoldina, a member of the National Academy of Science and Engineering (acatech), and the president of Combustion Institute.

She has collaborated with scientists from the University of Science and Technology of China (USTC) to develop synchrotron-based diagnostic method of biomass pyrolysis, detect enol intermediates, and measure chemical structures of bio-alcohol combustion using novel synchrotron-based combustion diagnostic techniques. With her recommendation, more and more young scientists from China are holding positions in international combustion organizations and winning important fellowships in the field. She has also been actively engaged in offering suggestions to Chinese policy-makers, for instance at a roundtable discussion on innovation with Chinese President XI Jinping in 2012, and putting forward a proposal to the State Council about China's environmental protection and international development in 2014.

In January 2016, Prof. Kohse became the first female laureate of the Award for International Scientific Cooperation from the Chinese Academy of Sciences.

BCAS: Thank you Prof. Kohse for doing this interview with us. How do you feel to receive the CAS international cooperation award?

Prof. Kohse: It is a wonderful surprise and a great honor, especially in regard of the high significance of this award to support international collaboration.

BCAS: When was your first collaboration with scientists from China?

Prof. Kohse: My collaboration with Chinese researchers started through different networks. The Alexander von Humboldt Foundation in Germany has a very large and prestigious network all over the world and hosts many young scholars. This organization, for which I have been serving as a member and later deputy chair of its general fellowship selection committee as well as its International Advisory Board, was one point of contact with Chinese scientists, and I hosted a number of Chinese scholars in my laboratory. Furthermore, I met Chinese researchers through my contacts in the USA and through collaborations at Berkeley.

BCAS: Who are your major collaborators in China and what kinds of research have you been working on together?

Prof. Kohse: My major collaborators in China are at USTC in Hefei, Shanghai Jiao Tong University, Tsinghua University, and the CAS Institute of Engineering Thermophysics in Beijing. I would like to mention Prof. QI Fei, now from Shanghai Jiao Tong University but formerly from USTC, as one exemplary pillar of the long-term collaborations.

All collaboration partners and I work in combustion science. Combustion is a major source of energy, and we investigate especially its environmental impact and cleaner solutions. The field of energy and the impact of combustion on air quality as well as on climate change is one of the major challenges worldwide. Such research questions do need collaborative research.

BCAS: What are China's opportunities in combustion research?

Prof. Kohse: In our field, especially in engineering, I have witnessed a transition from a problem-solving approach to including more long-term fundamental research as the basis for next-generation innovations. I think that this is a very important step since it enables researchers to understand not only a momentarily given problem but to have a long breath in development of original and new approaches, both in providing fundamental insights as in creating new processes and technology.

It is highly appreciated that in China, larger-scale research programs now support this long-term approach. The hiring programs for young scholars who have spent time abroad are also making a significant impact since those scientists bring and integrate their own networks and thus multiply collaboration.

I appreciate another initiative introduced by CAS – that is, to move forward from a more quantitative assessment of publications and citations to instruments that honor quality.

With a transition from a developing country to an internationally leading country in technology and innovation, further strategic components may have to be investigated that scout already for talents in school, that support collaborative approaches already early on, and that offer interesting academic career opportunities also outside of the major international hubs.

BCAS: Besides research cooperation, you have been actively recommending scientists from China to

hold important positions in international organizations and helped them win top scholarship. What is your motivation behind this?

Prof. Kohse: China has become a major scientific player in my research area within about the last decade. It is important regarding the quality of international research of societal and environmental impact as ours to be inclusive. I have been fortunate through my visits to China and lectures in many institutions to meet a large number of Chinese scientists. Also, as an editor-in-chief of a leading combustion journal, I could watch the exponential development of Chinese contributions, and I could follow the development and academic achievements of many Chinese scientists. In my present role as the president of the International Combustion Institute, it is one of my duties and pleasures to identify talents and leaders for many activities, and it is my strong belief that such talents and future leaders should be identified early and be given the chance to grow. Knowing many promising young Chinese scholars has helped in putting their names forward in international competition.

BCAS: You have become an influential advisor to China's science policies. For example, in 2012, you were invited to a roundtable discussion with XI Jinping at the Great Hall of the People, and you offered suggestions on how to make China an innovation-oriented country.

Prof. Kohse: Yes. It was an important meeting. I was impressed about the value and emphasis Mr. XI placed early on in his leadership of the country on the international collaboration in research and development. The honor of being received by him and high-ranking officials in the Great Hall of the People was memorable. I was given the honor to speak. Some of the aspects I had the opportunity to mention concerned, for the individual scientist, a good research question that should be investigated with an open mind, initiative and originality. On the institutional scale, I emphasized the need for a stimulating research climate that supports open and critical thinking, for interdisciplinary exchange, and for clear career paths for young people to invest into the future. For the national and international level, my speech addressed the chances associated with an open spirit of interaction and of a system that rewards originality, scientific honesty and rigor. Mr. XI acknowledged in his comment that I made some interesting suggestions.

BCAS: Then in 2014, at the invitation of the State Administration of Foreign Experts Affairs, you again put forward many useful suggestions on China's environmental protection and international development.

Prof. Kohse: That's right. The possibility to offer suggestions was highly appreciated. For example, air quality is one of the major problems in many regions, and cleaner strategies to deal, for example, with agricultural remains, could help to improve it. My Chinese colleagues and I had commented on such strategies.

BCAS: You are the first female laureate of the award. What are your messages for young women scientists in China?

Prof. Kohse: Encouragement is one of my key messages. Women scientists should first of all believe in their own talent. Second, it is useful to meet others in similar situations – it is much better to share experiences when you are not the only one in a given situation. Third, the academic system also should offer encouragement, potentially through mentoring networks, by parenting support and many other factors. Fourth, hiring and award committees should strive hard to identify promising female candidates. If they are not yet ready, they might be in a few years if you give them opportunities to grow!

BCAS: Thank you very much. Last question: what are your plans for future cooperation with China?

Prof. Kohse: I am looking forward to many interesting interactions. Right now, I host a very bright female Chinese doctoral student with a scholarship award in my group, and we have just submitted a research paper with her. I will welcome the next Chinese Humboldt Fellow in my group shortly to collaborate on transportation fuel chemistry, and another (Vietnamese-origin) Humboldt Fellow in my group is about to depart to the National Synchrotron Radiation Laboratory in Hefei where our joint Chinese-German proposal has competitively been awarded measurement time devoted to the study of specific combustion reactions. I will travel to China again and I also look forward to interact with the large network of Chinese friends and collaborators at our World Congress, the 36th International Symposium on Combustion, to be held in Seoul, South Korea, this summer.

Working Together on Abological Self-Assembly for Ten Years and Beyond

—— An interview with Prof. Peter John Stang

Prof. Peter John Stang is a Distinguished Professor of Chemistry at the University of Utah, who pioneered and developed the use of dative, metal-ligand interactions and coordination-driven self-assembly for the formation of large scale, high definition nanoscale complexes with two (2D) and three (3D) dimensional assemblies. His ground-breaking contributions to the development of abiological self-assembly have bagged him numerous prizes and honors, including the National Medal of Science and the American Chemical Society's Priestly Medal.

Over the last dozen years, Prof. Stang has committed much effort to the promotion and strengthening of the scientific cooperation between China and the USA. He has conducted research cooperation with Chinese scientists in the area of abiologically self-assembled supramolecular ensembles, which has produced fruitful results. With his effort, the American Chemical Society and the Gordon Research Conference have sent a number of high level delegations to China to facilitate and establish linkage with the Ministry of Science and Technology, the National Natural Science Foundation of China and CAS.

Prof. Stang is a laureate of the 2015 Friendship Award, and International Science and Technology Cooperation Award of China and the 2014 CAS Award for International Scientific Collaboration. He is also a foreign member of CAS.

BCAS: Congratulations, Professor Stang! What does this new cooperation award from the Chinese government mean to you?

Prof. Stang: This award is a tremendous honor and it means a great deal to me. It is among my most cherished awards. I very much enjoyed being in the Great Hall of the People and receiving this prestigious award in the presence of President XI Jinping, Prime Minister LI Keqiang and other dignitaries.

BCAS: You also won last years' CAS award for international cooperation. As you have been working with scientists from the CAS Institute of Chemistry for more than a decade, how did your collaboration start in the first place?

Prof. Stang: I visited China in 2004 and gave a lecture at the Institute of Chemistry of CAS (ICCAS) in Beijing and met with a number of scientists at the institute including Professor WAN Lijun (who shortly after became director of ICCAS). He is an expert in electrochemistry, STM and AFM. We talked about observing our self-assembled metella-cycles and metella-cages on surfaces via STM, etc. I sent him some of our samples, and he and his coworkers were successful in getting very nice STM images of our molecules on gold and highly oriented pyrolytic graphite surfaces. At the time, Utah did not have this capability or the expertise to do such surface studies.

Prof. Stang gives a talk on abiological self-assembly at Hangzhou Normal University's College of Material, Chemistry and Chemical Engineering, October 29, 2013. After the lecture, he was awarded honorary professorship of the university. (By courtesy of Prof. Stang)

We jointly published several papers in this area.

BCAS: How has the partnership evolved over the years?

Prof. Stang: My collaboration with Professor WAN continues. I have also started collaborations with Professor HAN Keli in Dalian on the photophysical properties of our compounds. This has also been very successful and resulted in several joint publications. More recently, I am also collaborating with two former very good and creative postdoctoral fellows in my group who are now having faculty positions in China: Professor HUANG Feihe at Zhejiang University in Hangzhou and Professor YANG Haibo at East China Normal University in Shanghai. I have also been very fortunate to have a number of excellent visiting scholars from various universities in China and we have continued collaborations with these faculty members after their return to China. Our collaborations focus on both the fundamental aspects as well as the potential applications of coordination driven self-assembly processes including novel metella-polymers.

BCAS: What is your motivation behind all these efforts?

Prof. Stang: Science always has been and continues to be international. Most cutting-edge research problems are very challenging and are best solved by collaborative efforts. Over my 45 year career in science, I have collaborated with numerous scientists worldwide but in particular scientists in Asia and Europe. It is both rewarding and fun to collaborate with fellow scientists around the world. Not only do I learn new science and new techniques by such collaborations, but I also learn about the traditions and culture of many countries. As I often say when I visit China; I like Chinese culture, Chinese history, the Chinese people, and of course Chinese food.

BCAS: You are well known for your innovative work in abological self-assembly. What do you think are China's opportunities and challenges in research innovation?

Prof. Stang: I am very impressed by Chinese science, particularly science in the last 10 to15 years. There is excellent chemistry in many outstanding Chinese universities and CAS institutes. Every top chemistry journal in the world has increasing numbers of excellent publications from China, including the *Journal of the American Chemical Society* (JACS) that I am the Editor of. The Chinese government recognizes and appreciates the importance of science and the role it plays in the modern world. Hence it strongly supports and invests in science. China needs to be sure that the most funding goes to the best science and scientists.

Welcome by students from the Southwest University for Nationalities upon Prof. Stang's arrival in Chengdu in 2012. (By courtesy of Prof. Stang)

BCAS: What about CAS? How could CAS stand itself out, among other research institutions and universities, to keep its leading role in China's research system?

Prof. Stang: CAS is a truly outstanding organization with great influence on science in China. CAS can be a leader in ensuring that Chinese science continues to be both world class and also serves the needs of Chinese society. Both basic, curiosity-driven, fundamental research and applied research are important for the future economic development and well being of the people of both China and the USA.

BCAS: What are your messages for young scientists in China?

Prof. Stang: Young scientists in China are fortunate to live at a time when science is rapidly advancing. Young scientists need to take advantage of new techniques and emerging areas within fields. They need to be passionate about their science and their work. They need to make significant individual contributions to their field as well as learn how to be members of productive teams and benefit from collaborations.

BCAS: What are your plans for future cooperation with China?

Prof. Stang: As long as I am research active I will continue to collaborate with colleagues in China, both with current collaborators as well as new ones. With the help of collaborators I will seek new, exciting ventures in abiological self-assembly. Abiological self-assembly is a relatively young field with lots of exciting discoveries yet to come.

Three-decade Devotion to Sino-Swedish Cooperation on Protein Purification

—— An interview with Prof. Jan-Christer Janson

Professor Jan-Christer Janson with his three medals. From left: The Friendship Award (2015), the CAS Award for International Scientific Collaboration (2014) and the International Science and Technology Cooperation Award of China (2015). (By courtesy of Prof. Janson)

Dr. Jan-Christer Janson is Professor Emeritus at the Department of Chemistry of Uppsala University, Sweden. He is a distinguished bio-separation scientist known for his contributions to modern protein chromatography on an industrial scale, in particular, for the development of cross-linked agarosegel chromatographic media and columns that have been widely used in the bio-pharmaceutical industry.

Starting from 1980, Prof. Janson has been actively engaged in collaboration with Chinese biotechnologists. He has helped China to design and develop industrial separation and purification processes for several recombinant pharmaceuticals, including hepatitis B vaccine (HBsAg) and interferon gamma. These products have been manufactured by Chinese biopharmaceutical industry in large quantities. He has also played an intrumental role in the design of chromatographic techniques for the separation and purification of active components in traditional Chinese herbal medicine. As an international advisory board member of the State Key Laboratory of Biochemical Engineering, he helped to set up a bio-separation research platform and proposed several on-column proteins refolding techniques and developed anti-denaturation technologies with his Chinese collaborators.

As of 2014, Prof. Janson has published 52 papers with collaborators from China in top international journals, and invited 41 Chinese students and scientists to his laboratory as guest researchers at the Biomedical Center of Uppsala University. He has visited China for more than 100 times and delivered nearly 150 lectures on protein purification in 35 different cities, having benefited over 20,000 scientific professionals and students.

In January 2015, Prof. Janson received the CAS Award for International Scientific Collaboration from CAS President BAI Chunli, and in September the Friendship Award of China from Chinese Vice Premier LIU Yandong. On January 8, 2016, he was conferred on the International Science and Technology Cooperation Award of China by Chinese President XI Jinping in Beijing.

BCAS: Congratulations, Professor Janson! What does this new award mean to you, and how was it like when you received it at the Great Hall of the People?

Prof. Janson: The award means the highest

The National Training Class on Bio-product Downstream Processing, which was organized by Professor Janson from April 1 to 19, 1985 in Wuhan. (By courtesy of Prof. Janson)

recognition of my 35 years' cooperation with Chinese scientists and biopharmaceutical companies. It is a great honor to me and to my collaborator friends Professors MA Guanghui and SU Zhiguo of the Institute of Process Engineering, Chinese Academy of Sciences, who recommended me for this award. It is also an encouragement to the Sino-Swedish scientific cooperation.

The awarding ceremony was a fantastic, almost supernatural experience: to be surrounded by an audience of more than 3,000 in the Great Hall of the People at the Tiananmen Square in the middle of Beijing, and to receive the finest award a foreigner can obtain in the field of science and technology from the hands of the paramount leader President XI Jinping.

BCAS: What is the separation and purification of protein? How did your collaboration with China start in the early 1980s?

Prof. Janson: The proteins we separate and purify are mostly pharmaceuticals that are used for treatment or prevention of diseases threatening the health of human beings, such as cancer, hepatitis, diabetes, etc. These protein pharmaceuticals are produced by recombinant bacteria or by animal cell culture. In order to be safe and effective, all impurities from the bacteria or animal cells have to be completely removed and the proteins have to be absolutely pure. This can only be achieved by sophisticated and optimized biochemical separation techniques, primarily based on chromatography. Without separation and purification, there would be no modern protein pharmaceuticals.

At Uppsala University, Sweden, we have a very long tradition of protein separation and purification originating from the work of two Nobel Prize winners, Theodor Svedberg (1926) and Arne Tiselius (1948) and their successors at the Institute of Biochemistry.

The pioneering work on electrophoresis and chromatography by Arne Tiselius (1902–1971) was early recognized by Chinese scientists and in 1966 he was invited by the famous Professor WANG Yinglai (1907–2001), then President of the Chinese Biochemical Society, to visit the Shanghai Institute of Biochemistry, CAS, where the scientists under the leadership of Professor WANG had just published the first ever chemical synthesis of bovine insulin. As a young PhD student I vividly remember the fascinating report Professor Tiselius

Meeting at China National Center for Biotechnology Development (CNCBD), Beijing, April 1990. (By courtesy of Prof. Janson)

Prof. SU Zhiguo and Prof. MA Guanghui at Professor Janson's home in Uppsala, Sweden. (By courtesy of Prof. Janson)

gave us during a staff meeting at our institute upon his return from this visit to China.

Very soon after the 3rd Plenary Session of the 11th Central Committee of the Communist Party of China convened in December 1978, CAS identified biopharmaceuticals as an important area for improving public health and Sweden as an important source of knowledge in the field of protein separation and purification technology to be used for the development and production of modern drugs from biological sources.

So, in early 1979, CAS asked Professor TSOU Chenlu of the Institute of Biophysics to contact the Swedish Academy of Sciences in Stockholm to organize a course on biochemical separation technology to be held at the University of Science and Technology in Beijing, October 6–19, 1980. The Swedish Academy of Sciences then asked Professor Per-Åke Albertsson from the Department of Biochemistry of Lund University to organize the course with prominent Swedish professors as lecturers and representatives for two Swedish companies, LKB Products in Stockholm and Pharmacia Fine Chemicals (PhFCh) in Uppsala to organize the experimental part of the course. As the Scientific Director of PhFCh, I was invited to be responsible for the chromatographic experiments.

In March 1986, the "863 Program", which is the code name for the first program on high-tech research and development in the People's Republic of China, was proposed to the central government and was approved by the State Council and an enlarged session of the Political

Bureau. The State Science and Technology Commission (SSTC) was then responsible for the organization and implementation of the 863 Program, which was divided into eleven subjects within five highly prioritized areas, namely: biotechnology, information technology, automation technology, energy technology, and advanced materials.

Responsible within SSTC for the implementation of the biotechnology program was the China National Center for Biotechnology Development (CNCBD) and one of the aims of the program was to improve the general level of health of the Chinese people. CNCBD was founded in 1985 and was responsible for the national policy and regulatory affairs on biotechnology. While coordinating biotechnology research activities throughout China, it also undertook a national long-term plan on biotechnology R&D and industry, promoted international cooperation in terms of collaborative research and business arrangements, organized and implemented a "torch plan" in biotechnology.

During the period April 1-19, 1985, the same year as CNCBD was founded, I accepted to organize the “National Training Class of Bio-product Downstream Processing” at Wuhan Medical College in Hubei. This information reached the recently appointed Director of CNCBD, Mr. LIU Yonghui, who sent one of his staff Dr. WANG Lifeng to attend the course. During the course, Dr. WANG, on behalf of CNCBD, forwarded the proposal to start up a collaboration program with Pharmacia Biotech, Uppsala, Sweden, on the development of purification processes for new, modern biopharmaceuticals.

This first contact was followed up by a “Letter of Intent” dated on October 17, 1986 and a “Memorandum of Agreement” drafted in Beijing on May 11-12, 1987. On October 6, 1987, a “Programme for Cooperation” was signed in Uppsala by representatives of CNCBD and the company Pharmacia Biotech.

As a consequence of this cooperation programme, three successful projects leading to industrial production of biotech drugs in China were carried out between 1988 and 1993. The expression systems for all three products were developed under the leadership of the Chief Scientist of CNCBD Professor HOU Yunde from the Institute of Virology, Chinese Academy of Preventive Medicine in Beijing. The purification processes were developed in Uppsala by teams built up by visiting scientists from Professor HOU’s institute, scientists from the three Chinese companies involved and scientists at Pharmacia Biotech and Uppsala University. The three product development projects were: (1) Recombinant Hepatitis B

Professor Janson and his Chinese colleagues at the State Key Laboratory of Biochemical Engineering, CAS Institute of Process Engineering. (By courtesy of Prof. Janson)

surface antigen (rHBsAg) for vaccine production, October 1988 – May 1989 (Ms. MEI Yafang and Mr. LI Bin), with production at the Changchun Institute of Biological Products, Ministry of Public Health, Changchun, Jilin under the supervision of Director ZHANG Quanyi; (2) Recombinant Human Interferon Gamma (rhIFN-γ), November 1990 – May 1991 (Dr. ZHANG Zhiqing and Prof. TONG Kuitang), with production at the Shanghai Institute of Biological Products, Ministry of Public Health, Shanghai; (3) Recombinant human Granulocyte Macrophage Colony Stimulating Factor (rhGMCSF), November 1992 – May 1993 (Ms. ZHOU Yuan and Ms. WANG Shicong), with production at NCPC Genetech Biotechnology Development Co., Shijiazhuang, Hebei.

The next big process development project in China was initiated in January 1997 when I was approached by Dr.JIN Yunhua, Executive Chairman, Committee on Technology, State Pharmaceutical Administration of China (SPAC), who forwarded a proposal from Mr. LÜ Weichuan, President of North China Pharmaceutical Group Corporation (NCPC), Shijiazhuang, Hebei. The proposal concerned a collaboration effort on the development of an industrial purification process for recombinant human serum albumin (rHSA) produced in the yeast *Pichia pastoris*. Preliminary laboratory scale experiments were first performed in laboratories belonging to Pharmacia Biotech in Beijing but in March 1999 moved to Uppsala, Sweden. Both the fermentation and the protein purification processes were developed at Uppsala Biomedical Center by invited NCPC staff together with staff from the university and Pharmacia Biotech. The purification process development work in laboratory scale was finished in January 2002. Scaling-up to pilot scale was started in September 2003. The outcome of the experiments was a success why the management of NCPC decided to invest in a new production facility for both fermentation and downstream processing. The new factory was inaugurated in late 2011 and the undersigned was invited on November 4, 2011 to see it from the inside before sealing the premises and start of production. The original idea to produce a clinical rHSA for intraperitoneal administration was gradually abandoned and currently the product is marketed as an additive and stabilizer of vaccines and other pharmaceutical products.

I am fortunate to have a long history of collaboration with a particular scientist from CAS who has also been working on protein separation and purification. It started in 1994 when I read a paper "Bio-separation in China" written by Professor SU Zhiguo. I wrote to him, suggesting that we would design a collaboration program. He responded to me quickly and we started joint research that ever since has been very fruitful. Now I am on the International Advisory Board to the National Key Laboratory of Biochemical Engineering under the CAS Institute of Process Engineering. I am also an honorary Professor at a number of universities and institutes in China.

BCAS: What about your collaboration with China in the field of traditional Chinese medicines? Which kinds of research are you working on together?

Prof. Janson: My interest in the purification of active components of traditional Chinese herbal medicine (TCM) was initiated by my collaboration with Professor and Academician TAN Tianwei from the Beijing University of Chemical Technology and Professor SU Zhiguo and Professor GU Ming at the CAS Institute of Process Engineering. Together with Professor TAN and his students we have developed new methods for the purification of polyphenolic TCM by hydrophilic (hydrogen bond) interaction chromatography. These methods are very selective why it is possible to isolate pure substances in one single chromatographic step from a crude plant extract. Examples are the isoflavonoid puerarin from *Pueraria lobata*, Danshen and other components of *Salvia miltiorrhiza* and epigallocatechin gallate (EGCG) from green tea. Together with Professor SU and Professor GU, we have performed systematic studies on the mechanism of retention and the optimization of hydrophilic interaction chromatography of both peptides and polyphenols of different structures and applied this knowledge for the purification of several components in extracts of the herbs *Polygonum cuspidatum* and *Geranium wilfordii*. Altogether 21 scientific reports were published in respected international journals as a result of my cooperation in the TCM area with professors TAN, SU and GU. Using the techniques and methods we have developed, it should be possible to design large scale processes for industrial production of these active components.

BCAS: Over the past three decades, you have co-authored over 50 research papers with scientists from China. You have visited this country for more than 100 times, and delivered 150 lectures in 35 different cities. What is your motivation behind all these untiring efforts?

Prof. Janson: From the very beginning of my

lecturing activities in China, my strongest motivation has been the very strong appreciation I have received from students all over the country, combined with their extraordinary eagerness to learn new techniques and methods for biomolecular separation and purification. The other, equally strong, motivation has been the warm and long-standing friendship with Chinese professors and scientists I have enjoyed over so many years. I have witnessed the fast development of China over the last 30 more years and am proud of having been accepted as a member of excellent research teams. I love China, love the people, and very much appreciate the happiness I feel every time I am here.

BCAS: What is the thing that you are most proud of doing in the process of collaboration?

Prof. Janson: I am most satisfied and proud of that I succeeded in receiving big grants from both the Swedish government and from the company Pharmacia Biotech, which made it possible for me to periodically invite more than 30 Chinese students to work in my laboratory at Uppsala Biomedical Center, during the time frame 1980–2006. Most of these students came from Professor LIU Zheng of the Department of Chemical Engineering, Tsinghua University, Professor SU Zhiguo of the National Key Laboratory of Biochemical Engineering, CAS Institute of Process Engineering, and Professor TAN Tianwei of Beijing University of Chemical Technology. The research grants given for collaboration with Professor LIU and Professor SU were used for the development of new techniques and methods for the refolding of recombinant proteins from inclusion bodies in the bacterium *E. coli*. A total of six scientific papers were published in respected international journals as a consequence of the refolding project collaboration. I am also very proud of a more recent collaboration with Professor MA Guanghui from the CAS Institute of Process Engineering. Professor MA is an expert on polymer technology and has invented an ingenious membrane emulsification technique for the production of narrow-disperse porous particles for various applications. In biotechnology the foremost use is for high resolution chromatography of macromolecules such as proteins. My contribution was as an advisor regarding the use of agarose as a matrix material as a complement to synthetic organic polymers such as polystyrene. This idea turned out very successfully and a commercial agarose gel based product is now available on the market from GE Healthcare Biosciences, Uppsala, Sweden.

BCAS: China is aiming at building a more innovative research system. What do you think is the key to research innovation, and what are China's opportunities and challenges?

Professor Janson and students at the CAS Institute of Process Engineering. (By courtesy of Prof. Janson)

Prof. Janson: According to a statement by Joseph Needham (1900-1995), a British sinologist known for his scientific research and writing on the history of Chinese science, no previous civilization paid more attention to recording and honoring ancient inventors and innovators than that of the Chinese. Texts that might be called techno-historical dictionaries or records of inventions and discoveries form a distinct genre of Chinese literature. My interpretation of the decline in technological development that occurred after the fall of imperial China more than 100 years ago was the severe unrest and poverty that followed as an effect of warlords fighting each other, the Japanese invasion and the atrocities and hardships that followed during the Second World War. After the liberation in 1949 most of the effort was focused on the unification and rebuilding of the country followed by the unfortunate period of the Culture Revolution. Since then China has achieved an incredibly fast development of a new socio-economical infrastructure and rebuilt its universities and scientific institutions. So, I believe it is just a matter of time before China has reinstated its position as an innovative super power. Compared to the situation in the West, the centuries old Confucian tradition to honor the learned, hesitating to criticize and challenge old truths, has been an obstacle for new ideas to thrive. However, I think this is a temporary problem that will be compensated for by coming generations of scientists.

Meanwhile, innovation requires joint effort from scientists and the people of industry including entrepreneurs. Government should set up policies to encourage industry or entrepreneurs who actively invest money to research institutions for joint technology research. Scientists, on the other hand, should also actively participate in such collaboration instead of running for SCI publications. Of course publications are important, but for China, I think technology innovations are more important.

BCAS: Your message for young scientists in China?

Prof. Janson: Chairman Xi Jinping has stated that young people should "dare to dream, work hard to fulfill the dreams and contribute to the revitalization of the nation". I believe this is particularly important for those young scientists who have been fortunate to be born with a creative mind. However, creativity leading to innovations in most cases comes to the prepared mind or to a group of scientists whose minds are prepared in a complementary way. Minds are prepared by own scientific experience, by reading other scientists work and by studying theoretical texts of subjects that gives the reader joy and satisfaction. The key word is cross-fertilization which often occurs when young scientists meet established scientists of different disciplines for open discussions at seminars or in the coffee room.