CHINA SCIENCE AND TECHNOLOGY NEWSLETTER

Department of International Cooperation
Ministry of Science and Technology(MOST), P.R.China

No.16
August 30 2015

Special Issue: A Galaxy of Eminent Scientists

Pei Duanqing: "Spring of Youth" in Urine

Pei Duanqing, Director General of the Guangzhou Institutes of Biomedicine and Health, Chinese Academy of Sciences, derived induced pluripotent stem cells (iPSCs) from urine and, after cellular reprogramming, injected the iPSCs-origin cells into an impaired human organ. This process can turn cells in any stage, even cells of the seniors, into pluripotent cells of the early embryotic stage, and thus make tissues and organs "young" once again.

The research team led by Pei Duanqing found through experiments and research that vitamin C has unique properties of iPSC induction and can increase iPSC inductivity by 1/10. Their work on improving reprogramming efficiency by adding vitamin C to a

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substrate was published in a cover article in Cell Stem Cell. Moreover, their research on the molecular mechanism of how vitamin C activated histone demethylases Jhamla and Jhdmlb to slow cell aging and as well activated miR-driven somatic reprogramming appeared on the cover of Cell Stem Cell again. His research team also successfully derived iPSCs from adult fibroblast cells of Tibetan piglets. All these were in China, pioneering activities in the research on stem cell pluripotency and somatic reprogramming.

The research team found under the microscope that after being induced for several days, adult fibroblast cells gradually became epithelial cells and, on this basis, made the hypothesis that the formation of iPSCs is initiated by the mesenchymal-to-epithelial transitions (MET) process. Their subsequent research that confirmed this hypothesis was published in Cell Stem Cell and was selected by Science and Technology Daily as one of the top ten science and technology news stories in China in 2010. Guided by the EMT-MET theory, they made the unprecedented discovery of the existence of epithelial cells in human urine and the ability of such cells to efficiently induce iPSCs. Pei Duanqing and his team also found that the epithelial cells in human urine can directly induce neural stem cells and provide a new approach to the treatment of neurologic diseases. The research was published in Nature Methods and was featured as a headline in Nature's official website. These research activities, making conceptual breakthroughs in the understanding of MET, have shed light on new channels and methods of iPSC research and provided a typical case of theoretical studies before real-life applications.

(Source: Science and Technology Daily,
May 22, 2015)

Lai Yuanming: Burning Love for High-Altitude Frozen Ground

Lai Yuanming is a leading scientist at the Cold and Arid Regions Environmental and Engineering Research Institute of the Chinese Academy of Sciences. For decades he has led his team in "frozen soil and cold regions engineering" research in Lanzhou, in the remote areas of western China, and made significant accomplishments. In the study of warm frozen soil at -1 °C, Lai and his team first focused on the frost-damage mechanism in cold regions engineering and provided locally informed theoretical support to project design in cold regions, putting an end to the reliance on foreign studies in frozen soil calculation.

Confronted with limited availability of data and literature, Lai leveraged his solid training in engineering mathematics and engineering mechanics and put forward a mathematical-mechanical model of frozen soil temperature, seepage and coupled stress. On this basis, he derived a finite element formula of numerical simulation of the stress field and temperature field under the influence of frost heave load and solved the problem of frozen substrate temperature measurement, which filled a gap in cold regions tunnel calculation and provided a world-recognized calculation model for frozen ground engineering.

On the basis of revealing the mechanism and effect of substrate temperature decrease, Lai and his team developed a series of innovative physical structures including U-shaped composite riprap subgrade and ventilated substrate with automatic temperature control and no energy consumption, which have been successfully applied to the construction of the Qinghai-Tibet Railway and highroads. An application document of the construction headquarters of the Qinghai-Tibet Railway noted that the structures helped reduce the construction of 30 kilometers of viaducts, enhance 100 kilometers of substrates and prevent the occurrence of potential damages such as substrate sinking and road rupture, thus reducing a great amount of costs on construction and maintenance. In 2008, Lai Yuanming was recognized with a Special National Prize for Progress in Science and Technology as a main contributor to the Qinghai-Tibet Railway construction.

(Source: Science and Technology Daily,
May 25, 2015)

Fan Yunliu: Half a Lifetime Spent on Transgenic Technologies

The famous biologist, Fan Yunliu, the member of the Chinese Academy of Engineering, has devoted half of her lifetime to one thing that is combining molecular biology and traditional agriculture and applying genetic technologies to enhance agriculture. She founded the first research institute of molecular biology for agriculture in China which bred the first genetically-modified insect-resistant rice and cotton varieties in China. Her team also bred the first commercial GM phytase corn in the world.

Fan has extend her research on bacterial plasmid to genetic engineering science and technology and engage in agriculture-related molecular biology research. She established China's first agriculture-related research institute of molecular biology. Her laboratory made important breakthroughs in transgenic cotton technology. The laboratory mastered a critical core technique of insect-resistant cotton development, obtained transgenic Bt cotton plants, and artificially optimized the codons of naturally-occurring Bt genes. She led the establishment of a national research system covering the upstream, midstream and downstream and laid the foundation of personnel and technology for China's insect-resistant cotton industry.

Fan and other researchers such as Yao Bin have cloned phytase genes from Aspergillus niger. Fan's research team identified the promoter of specific expression in endosperm, shot micro-bullets containing phytase DNA into immature corn embryo having been pollinated for nine days using a gene gun and, after a series of complicated culturing, finally obtained corn seedlings containing phytase DNA. In 2009, the genetically modified phytase corn strain was granted the GMO Biosafety Certificate for production. The commercialization of the genetically modified phytase corn has secured China a strong position in the intense international agro-biotech competition.

(Source: Science and Technology Daily, May 29, 2015)

Ru Zhengang: "Ever-lasting Passion" for Wheat

The Aikang 58 wheat strain developed by Prof. Ru Zhengang at the Henan University of Science and Technology has been grown in over 260 million mu, leading to more than economic benefits worth over RMB 20 billion, and earned him the first prize of the National Award for Progress in Science and Technology in 2013. In recent years, Prof. Ru has been engaging in the technical research of accelerated new variety development. The new techniques can develop new varieties in the matter of two or three years and have brought a revolution to the breeding of not only wheat varieties but also other crops.

Ru has established a full series of research facilities at the Henan University of Science and Technology, including molecular biology laboratory, artificial climate chamber, intelligent greenhouse and outdoor experimental field, which have reduced the breeding time of new wheat varieties by six years.

Having been engaged in wheat breeding for more than three decades and left his footprints in most wheat-growing regions of China, Ru worked on research projects based on the needs and problems of wheat-growing farmers and broke the bottleneck of wheat breeding.

The male sterility line BNS bred by Ru has featured prominently in China's hybrid wheat research and promotion. It has been planted experimentally in 200 mu of land in Xinxiang with encouraging results. In the latest development achieved only several days ago, he perfectly added a disease-resistant gene to the new variety and made it even more superior.

(Source: Science and Technology Daily, May 30, 2015)

Xue Qikun: Spying on "Abnormality" in Microscopic World

In October 2012, physicist Xue Qikun observed the quantum anomalous Hall effect in experiment for the first time. The quantum anomalous Hall effect refers to the microscopic phenomenon of electrons moving swiftly in an orderly way in the absence of a magnetic field. This was the first time that Xue Qikun observed this phenomenon in an experiment.

The Science magazine issued on March 15 of 2013 reported that a research team from the Tsinghua University's Department of Physics and the Institute of Physics of the Chinese Academy of Sciences (CAS), led by CAS member Xue Qikun observed for the first time in an experiment the quantum anomalous Hall effect. That indicated that the long-awaited phenomenon was first captured by Chinese scientists.

Since his doctoral studies in 1992, Xue has been engaging in the systematic research of thin-film growth dynamics for more than 20 years and received two second prizes of the National Award for Progress in Science and Technology. According to Xue, the observation of the quantum anomalous Hall effect is not an end in itself, but the beginning of a new chapter of research. Xue has never stopped pushing his research. He told the reporter that the anomalous Hall effect is achieved at a temperature as low as near minus 273 degrees Celsius and, in order to make it useful practically, the temperature at which it occurs has to be increased. "If it can be achieved at the normal temperature, it will thrill physicists all over the world," Xue said.

It has been more than two years since Xue and his team observed the quantum anomalous Hall effect for the first time, and during the period good news kept coming: the quantum anomalous Hall effect has been observed at four overseas prestigious universities. Meanwhile, Xue and his colleagues have been continuously pushing their research, testing two samples every day, and have observed new phenomena including the Zero Hall Plateau.

(Source: Science and Technology Daily, May 31, 2015)

Wang Wenxing: "Combating the Monster" of Acid Rain

Acid rain and floating dust were the most prominent atmospheric pollutions in China. China became the third largest acid rain region, after Europe and North America. Wang Wenxing is the member of the Chinese Academy of Engineering, academic advisor of the Chinese Research Academy of Environmental Sciences and tenured professor of the Shandong University. He is the first to introduce quantum chemistry to the environmental field and applied it on the research of acid rain.

As the leader of the acid rain research group during the 7th Five-year Plan, 8th Five-year Plan and 9th Five-year Plan periods from 1986, he led, organized and personally participated in testing, experiment and research activities despite untold hardships and eventually figured out the spatial and temporal distribution of acid rain occurrence in east China. The research findings laid the foundation for China's acid rain policies and measures. In recognition of his great achievements, Wang was awarded the first prize of the National Award for Progress in Science and Technology, becoming the first scientist to win the prestigious prize in the field of environmental sciences and technology. In spite of being the largest industrial region in Asia, China has never experienced any large-scale acid rain accident as occurred in Europe and the North America in history.

As pollutants evolve in the environment, traditional experimental methods have often proved unsuitable. Wang was attracted by quantum chemistry and became convinced that with the emergence of new theories and methods, especially with the development and application of supercomputers, quantum chemistry computing would have its huge application potential increasingly manifested. After founding the Environmental Research Institute of Shandong University, Wang introduced

quantum chemistry to environmental chemistry research. Environmental protection has been the unifying theme of the three stages of his academic career from industrial catalysis to environmental chemistry to education. In his words, industrial catalysis paved the way for his environmental research and teaching extends his "dream of environment protection".

(Source: Science and Technology Daily, June 1, 2015)

He Jishan: Delight in "Grappling" with the Earth

He Jishan is a famous geophysicist as well as one of the first members of the Chinese Academy of Engineering. The wide field electromagnetic method (WFEM), his major invention in the past decade, has increased the reach of geological investigation to seven kilometers underground. He combined WFEM and the method of seismic exploration in shale gas exploration. His research project on the R&D of large-depth three-dimensional vector WFEM apparatuses received the support of the National Special R&D Program for Key Scientific Instruments and Equipment, granted by the National Natural Science Foundation of China.

The wide field electromagnetic method and dual-frequency induced polarization (DFIP) theory introduced by He Jishan has been widely known in the field of geophysical exploration and applied in many countries rich in mineral resources such as Iran, Brazil, Australia and Peru as well as 29 provinces and autonomous regions in China. They are powerful tools in metal ore prospecting and engineering. In China alone, they have helped identify more than RMB 200 billion worth of mineral resources.

Combining DFIP and his unique "three-element set close addition" method, He Jishan established a completed pseudo random signal electricity method system which makes it possible to send signals induced at any combination of frequencies and receive the feedback signals from underground rock, thus significantly increasing the efficiency and accuracy of detection. The combination of the pseudo random signal method and the wide field electromagnetic method led to an all-new electrical prospecting method.

Through over-and-over explorations, He Jishan developed the "flow-field fitting method" for detection of levee faults, drawing inspiration from the similarity between electric current field and water flow field. He developed the world's first "universal levee piping and seepage detector" able to quickly detect levee faults in tough flooding conditions. The device can be used in reservoir areas to quickly identify where water is leaking. So far, He Jishan and his team have applied the device to more than 110 levees nationwide and identified more than 20 faults.

(Source: Science and Technology Daily, June 8, 2015)

Wang Qinjun: Increase Intimacy between the Earth and Man

The research team of Wang Qinjun at the Institute of Remote Sensing and Digital Earth (RADI) of the Chinese Academy of Sciences (CAS) put forward the idea of "integration of band intensity and waveform characteristics" and developed a series of methods of high-accuracy geological environment and space information extraction. Meanwhile, his team also constructed the "land surface geological environment remote sensing and assessment model" and "quantitative disaster assessment model based on multi-factor logistic regression". Those have solved problems in the assessment of land surface geological hazards, the high-accuracy monitoring of land surface and the rapid pre-warning of disasters.

Wang and his team also invented the "lithological information enhancement method", "tectonic information enhancement method" and "altered mineral extraction

method based on measured spectra" which enable high-accuracy extraction of geological information in resource prospecting. The grouped high-accuracy mineral determination system developed by his team has provided a technological support for the promotion of hyperspectral remote sensing in geological studies. The system has been applied in extensive fields including rock-mineral determination, geochemistry, remote sensing prospecting, mineral resource exploration and mineralization modeling.

At RADI, currently Wang is mainly working on theoretical and applied research on the extraction of geological environment and space information. For geological environment researchers, what matter most are how to achieve high-accuracy identification of target prospecting areas, reduce outdoor workload and improve mineral prospecting efficiency in serious spectral mixing conditions, leverage remote sensing to achieve real-time dynamic monitoring of geological disasters to reduce disasters and benefit the people. Such endeavors are of great implications that make all their efforts worthwhile.

(Source: Science and Technology Daily,
April 8, 2015)