
# SICHUAN UNIVERSITY

## A 120-year journey to education and research excellence

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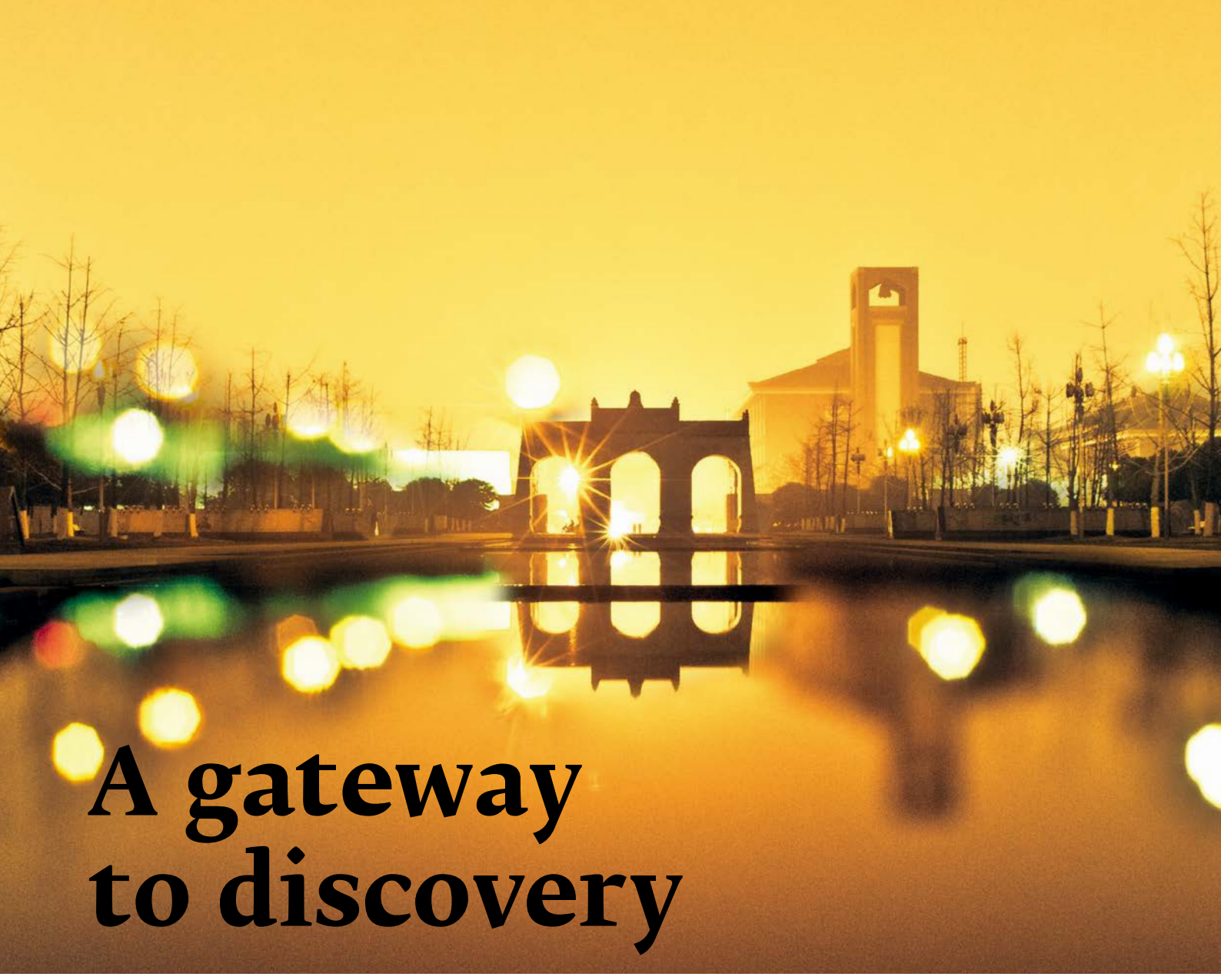


# A gateway to discovery

To mark the 120th anniversary and celebrate the start of the next stage of a brilliant journey, now is a time to reflect on the great strides made by Sichuan University (SCU). It is one of China's longest established modern universities with a history that can be traced back to the founding of Sichuan Sino-Western School in 1896, set up under the rule of Qing Dynasty Emperor, Guangxu. The current SCU was born of two mergers, first in 1994, with the former Chengdu University of Science and Technology, and then in 2000 with the former West China University of Medical Sciences.

Located in Chengdu, the culture-steeped capital of Sichuan province, SCU is a national key university under the direct administration of the Chinese Ministry of Education (MOE), and counts among the top 10 in the China University Rankings, compiled by the China University Assessment team. It has been designated for both the 211 Project and the 985 Project, and is of strategic importance in China's western development plan. It has now set its sights on becoming one of the world's first-class research universities.

SCU has three campuses in Chengdu, sprawling across 7,050 mu (470 hectares). It has 33 colleges, offering a comprehensive range of disciplines, covering humanities, science, engineering, management, medicine, law, agriculture, education and arts. It is authorized by the state to grant doctoral degrees in 44 disciplines. According to Thomson Reuters' Essential Science Indicators (ESI), 13 of its disciplines are ranked among the global top 1% and chemistry is ranked among top 1‰ globally. With 5,238 full-time faculty members, including 1,051 full professors, 1,230 associate professors and 15 members of the Chinese Academy of Sciences (CAS) and the Chinese Academy of Engineering (CAE), the university is enhancing its strengths in education and research, broadening international collaboration, and making greater social impacts. It has become a major driver of the socio-economic development in western China.

## Innovate above all

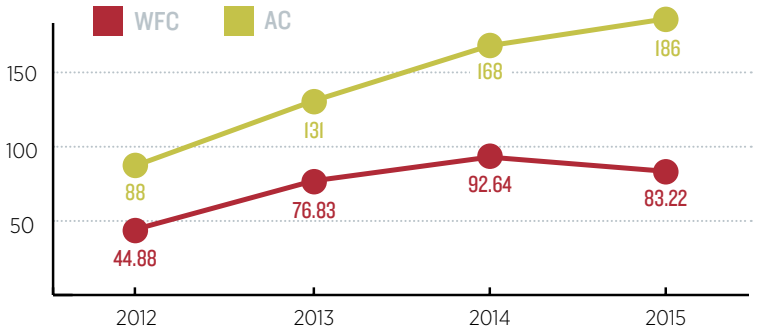
Research innovation is at the centre of SCU's plan to become a world-class university. Its many laboratories, research centres and bases have conducted projects of regional, national and international significance, putting it at 106th among global academic institutions in the Nature Index, based on the 2014 data. With 13 national key laboratories and engineering centres/laboratories, four state-level international science and technology cooperation bases, nine national centres for talent training, research and teaching, four MOE key research bases for humanities and social sciences, two National Drug Clinical Trial Institutes, and one National Drug Clinical Research Base, the university has won 39 national-level awards since 2005 for science and technology advancement. In 2014 alone, 3,647 papers were published in journals listed in the Science Citation Index (SCI), ranking 6th among Chinese universities.

For example, Feng Xiaoming's catalytic asymmetric Roskamp reaction provided a new method for the synthesis of chiral compounds. Studies on $CO_2$-mineralization are promoting the rise of a new energy industry. Cross-disciplinary studies on translational medicine led to an innovative technological chain of gene discovery — drug R&D — clinical treatment.

In the field of humanities and social sciences, the university also lists remarkable achievements. SCU expertise contributed to the compilation of several extensive cultural collections, including *The Chinese Dictionary*, *The Complete Works of Song Dynasty*, *A History of Chinese Daoism*, *The Confucianism (Ru Zang)* and other important works.

## From strength to strength

SCU's global ranking in the Nature Index rose from 278th in 2012 to 145th in 2015. The increase in WFC was 15th highest among institutions globally.




## Counting success

AC 2016

**190**

WFC 2016

**84.28**

* Based on Nature Index data 1 May 2015 – 30 April 2016

The Nature Index's AC refers to an institution's article count. The WFC measures the proportion of its contribution to those articles.

# Learning without borders

The university has a rich heritage and is dedicated to nurturing globally competitive innovators. It aims to reveal students' path to discovery, according to their personal aptitude for learning.

Through an integrated multi-disciplinary approach, SCU has developed an innovative training set-up that promotes personalized education and development. Broadening the world views of students is an integral goal for educators at SCU. To this end, exposure to a variety of fellow learners adds to a rich experience. Apart from more than 37,000 full-time undergraduates and 20,000-plus master and PhD candidates, SCU has nearly 3,000 international students.

It has also hosted a University Immersion Program (UIP), a successful two-week summer event that brings professors from across the world to lecture and teach. In the past five years, the UIP has won much acclaim by bringing in 610 professors from renowned universities, such as Harvard, Stanford and Oxford, and offering courses in English.


## A MASTERFUL CHOICE

Enjoying a long tradition in education, SCU has given rise to many renowned scholars.

Over the past 120 years, the university has attracted and nurtured masters such as historian **Gu Jiegang**, writer **Li Jieren,** aesthetician **Zhu Guangqian**, physicist **Wu Dayou**, botanist **Fang Wenpei**, public health expert **C. C. Chen**, and mathematician **Ke Zhao**.

The administrators of the university include leading figures in contemporary Chinese history, **Wu Yuzhang** and **Zhang Lan**, for example. The school has many famous alumni, including **Zhu De**, one of the founding fathers of the People's Republic of China, **Yang Shangkun**, China's former president, as well as **Guo Moruo** and **Ba Jin**, renowned masters of modern Chinese literature.

Also, more than 50 CAS and CAE academicians are SCU alumni. Currently, SCU has more than 700,000 alumni across the globe, many of whom are academic heavyweights, industrial elites, or leading administrators. SCU people are making great contributions to promoting socioeconomic development and advancing human civilization.

# Making a difference

Dedicated to promoting national and regional social and economic development, SCU is continually enhancing its capacity to serve through strong encouragement of innovation and entrepreneurship. SCU is among the first four universities designated as the demonstration base for innovation and entrepreneurship by the state, one of the first six national technology transfer centres and named a Model Institution or Corporation of Intellectual Property Right Protection.

One of the first 15 university science and technology parks approved by the state as pilot sites, the Science and Technology Park of SCU has incubated more than 50 science and technology enterprises, including one publicly-listed company.

In recent years, the university has established collaborative partnerships for production, education and research with more than 6,000 corporations in 150-plus regions and cities across the world, building more than 100-strong university-enterprise collaborative platforms .

Through these partnerships, the university has undertaken more than 13,000 projects leading to technological development, tech-transfer, technological service and consulting in many domestic and foreign enterprises. Several scientific and technological breakthroughs have been applied and their resulting uses have become leading technologies.

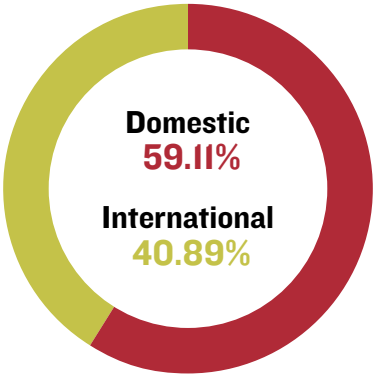
The merger with the West China University of Medical Sciences vastly improved SCU's capacity in clinical services. The four university-affiliated hospitals played an important role in casualty treatment after the Wenchuan earthquake and other major natural disasters, and have contributed greatly to improving population health of people in the region and around the world.

## A world of connections

International exchanges in education and research contributed to SCU's increased global reputation and standing. The university has established cooperative relationships with almost 240 world-class universities and research institutions, such as Oxford, Cambridge and Harvard, from 34 countries and regions. These partnerships resulted in high-level scientific collaborations, including the Sino-German Innovative Platform on Clean Energy and 24 other international collaborative research platforms.

To promote educational exchanges, the university has established all-English programmes, recruiting students from around the world. Following China's "One Belt, One Road" initiative, a scholarship is set up to encourage the applications of international students from the region. Working with several renowned universities in the United Kingdom, Germany, France, the United States, Belgium and South Korea, SCU has established Confucius Institutes overseas, promoting Chinese language and culture. As an effort to take advantage of quality educational resources elsewhere, the university has also built a joint institute with the University of Pittsburgh.

**International vs. domestic collaboration by WFC**




* Based on Nature Index data 1 May 2015 - 30 April 2016

A growing reputation has brought many international visitors, including the United States Vice-President, Joe Biden, the Chair of Russia's Federation Council, Valentina Matviyenko, the Governor of Australia, Quentin Bryce, Governor of Canada, David Johnston, and Nepal's Prime Minister, KP Sharma Oli, as well as renowned scientists like the 2009 Nobel Laureate in Chemistry, Ada Yonath, and Barry Marshall, 2005 winner of the Nobel Prize in Physiology or Medicine.

## Onwards and upwards

While proudly reflecting on the past 120 years, SCU is laying out new ambitions as it strives to become a top 100 global institution in the Nature Index. With the mission of advancing human civilization and meeting strategic needs of the nation, the university wants to capitalize on its strong subjects, advance multidisciplinary research, enhance basic science subjects and focus on pushing the frontiers of science to improve its global competitiveness and reach. There are four broad plans in place:

**1. Introduce and cultivate talented researchers and high-quality innovation teams.** Steps are taken to build up the talent pool, focusing on reaching out to and following up with talented young scholars across the globe, who have cross-disciplinary backgrounds and great growth potential. New hiring and salary incentive mechanisms are in place to facilitate recruitment and retention. The university also prioritizes providing opportunities and platforms to fast-track development of young researchers.

**2. Build high-level research platforms to facilitate cutting-edge science and exploit school-wide resources.** The university is constructing high-level discipline-specific and multi-disciplinary platforms. These will focus on new energy and low carbon technologies; chemical biology; big data in biomedical information; information technology; brain science and artificial intelligence; human genetic resources repositories and others. It is also planning to build on its current strengths in biotherapy, deep-Earth science and advanced functional materials to establish several "big-science" platforms and around 10 innovation platforms for international collaboration.

**3. Enhance basic science subjects.** SCU wants to identify and support its own specialty subject areas, particularly its strengths in mathematics and physics. The plan is to build several centres around specified research directions to boost innovation and collaborative development of these areas.

**4. Strengthen top-level international collaboration and extend academic exchange.** Colleges across the university are encouraged to establish meaningful innovation platforms for international collaboration and to participate in or lead big-science projects of international importance. The university is also making reforms to facilitate international collaboration.

"It is our goal and mission to become a world-class university," says Wei Yuquan, SCU's Vice-President. "We aspire to engage great ideas, cultivate people who can become pillars of the nation, make academic breakthroughs, advance science and technology, and lead social development."

NATURAL SCIENCE

# A natural achiever

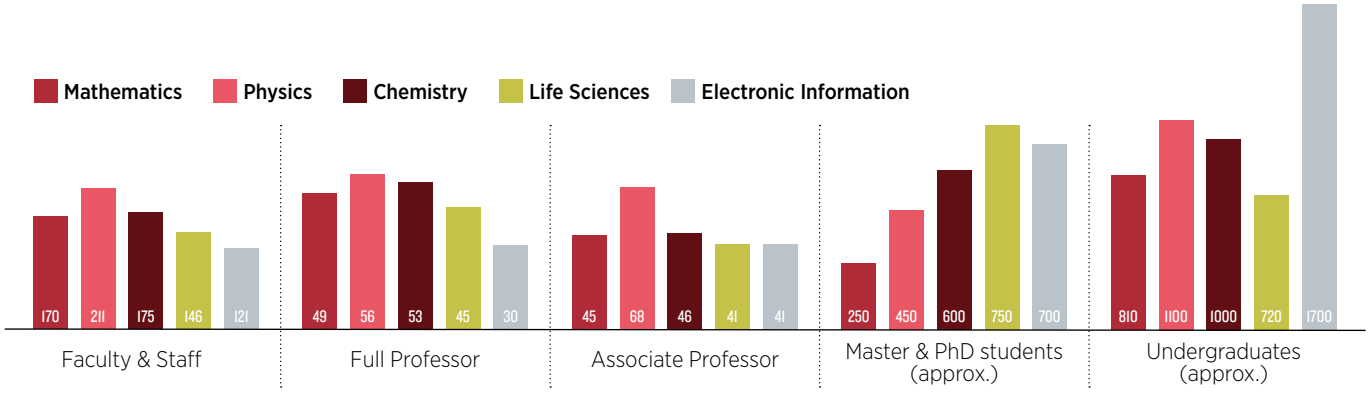
With roots in the hinterland of Sichuan Sino-Western School stretching back to 1896, the science schools at SCU contribute to the strong academic atmosphere of the university. The disciplines are concentrated in five schools: mathematics, physics, chemistry, life sciences and electronic information. A faculty team of 233 full professors, 241 associate professors, four CAS academicians and four CAE academicians are providing training to more than 2,750 graduate students and 5,300 undergraduates.

Researchers have produced prominent results through innovative research, particularly in environment-friendly polymers and green chemistry. Based on these areas, chemistry is currently ranked in the global top 1‰ in the ESI, while mathematics, physics, molecular biology and genetics are ranked among the top 1% worldwide.

Domestically, these schools are also lauded, scooping eight national awards for science and technology, and more than 40 provincial awards.

Several national-level laboratories have been established, including for high-energy density physics, radiation physics, environment-friendly polymer materials, bio-resources and ecology, biofuels, and new energy.

## A broad spread of knowledge and talent



# Physics

A leader in physics in southwest China, major research thrusts of SCU's College of Physical Science and Technology include atomic and molecular physics, condensed matter physics, theoretical physics, particle physics and nuclear physics, plasma physics, optics, high-pressure science and technology, as well as biomedical engineering.

In high-pressure physics, research on the insulator-metal Mott transition, named after the English physicist Sir Nevill Francis Mott, has led to breakthroughs in the study of correlated systems published in the prestigious *Proceedings of the National Academy of Sciences of the United States of America* (*PNAS*). He Duanwei, a leader in the field, has worked with his collaborators on a pressure-induced isostructural Mott transition in cubic multiferroic perovskite PbCrO3. They disclosed mechanisms of the transition and found that the ferroelectric distortion plays a key role in this phase transition. Their research, for the first time, provided experimental evidence to Mott's original proposition, which attributes the transition to the screening of Coulomb potential at high pressures.

**Top 5**
**SCU's international collaborators**

1. National Research Council (NRC), Canada
2. University of California, San Diego, USA
3. National Institutes of Health (NIH), USA
4. University of St Andrews, UK
5. The University of Texas MD Anderson Cancer Center, USA

* Based on Nature Index data 1 May 2015 – 30 April 2016

Condensed matter physics is another area at which the university excels. Applying the time-dependent density functional theory and molecular dynamics, Zhang Hong and his collaborators studied the dynamic process of femtosecond laser-induced electron excitation in material surface. They simulated helium ion microscopy (HIM) imaging of single-layer graphene, showing the possibility of using HIM to closely study the pattern of suspended graphene. The research finding was published in *Physical Review Letters*. Zhang suggests that the mechanism of HIM imaging is also applicable for other materials.

Much of the research conducted in the College of Physical Science and Technology is internationally collaborated. The college is active in several major global mega-science collaborations, including the International Thermonuclear Experimental Reactor (ITER) project, the LHAASO (Large High Altitude Air Shower Observatory) Plan, aimed at detecting high-energy gamma rays and cosmic rays for a better understanding of the evolution of the universe, and China's dark matter research project. The college has also organized several international conferences, such as those on surface plasmon polariton, strings, particles and cosmology, as well as condensed matter theory and computational material science, which promoted academic exchange between China and the rest of the world.

# Mathematics

The College of Mathematics has 170 full-time faculty and staff, including two CAS academicians. It focuses on topology, geometry, algebra, number theory, differential equations and dynamical system, mathematics of uncertainty modelling, control and optimization, as well as computational mathematics.

In the area of topology and fuzzy mathematics, Liu Yingming, a CAS academician, has conducted internationally influential research. He systematically investigated basic topology structure and advanced the theory of "topology on lattices". On algebraic topology, he solved a problem on CW complex, a type of topological space that allows for computation, introduced by British mathematician J.H.C. (Henry) Whitehead. Liu proposed a theorem that gives a necessary and sufficient condition for the producibility of CW-complexes. In disposition of fuzziness, together with his collaborators, Liu obtained succinct approximations of Kolmogorov representation for an important class of application-oriented functions, yielding a true method for dimension reduction. The work laid the foundation for the current theory of neural networks and promoted the industrial application of fuzzy techniques in China. In 2005, Liu was honoured as a Fellow of the International Fuzzy Systems Association (IFSA) for his distinguished contribution in the field.

Another CAS academician, Li Anmin, specializes in global differential geometry and symplectic geometry, with works published in *Inventiones Mathematicae*, one of the most prestigious journals on mathematics. Other faculty members at the school have also had important research results, with publications in globally-renowned mathematics journals, such as the *Journal of the American Mathematical Society*.

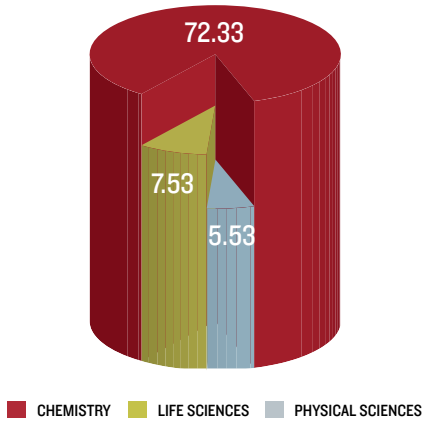
# Chemistry

Chemistry is a traditional Chinese strength and an important subject for SCU. Its College of Chemistry started in 1907 and currently has 175 faculty and staff, including two CAS academicians and one CAE academician. Its major research areas cover inorganic chemistry, analytical chemistry, organic chemistry, physical chemistry, polymer chemistry and physics, green chemistry, chemical biology and nuclear chemistry. Impressive results in green chemistry, asymmetric synthesis, halogen-free flame retardant polymer materials and biodegradable polymers have made significant impact on the global science community.

In particular, work on halogen-free flame retardant polymers, led by Wang Yuzhong, has had a significant outcome. Halogens are no longer used as flame retardants because the toxic gas they release are hazardous to health. Using 2-carboxyethyl (phenyl) phosphinic acid melamine salt, Wang and his team prepared flexible polyurethane foams with good flame-retardant and mechanical properties. They also studied other halogen-free materials and developed a novel halogen-free flame retardant system. Their research has widespread use in electrical applications, such as in insulating elements, and resulted in dozens of patents, several national science and technology awards and high-profile publications.

These remarkable research results are helped by active academic exchanges. Each year the college invites more than 50 renowned scholars from China and beyond for academic exchange, and sends more than 30 students and teachers abroad for educational exchange or collaborative research.

## Chemically active




**#14 SCU's national rank in chemistry output**

* Based on Nature Index data 1 May 2015 – 30 April 2016

## FENG: A CATALYST FOR THE EXTRAORDINARY

A shining SCU figure is the brilliant chemist, Feng Xiaoming, who is lauded for his research on chiral catalysis. Dedicated to asymmetric synthesis research, Feng and his team developed, for the first time, a highly efficient chiral catalyst for enantioselective reactions in asymmetric catalysis.

With optimized characteristics, at only 0.05 mol% catalyst, the chiral ligand can give high yields and excellent selectivity. The method can produce several optically active compounds with significant bioactivity.

In the book *Organic Syntheses Based on Name Reactions* (3rd edition) the new reaction was named Roskamp–Feng reaction to mark its impact. The research results were published in the *Journal of the American Chemical Society* and other key journals.

Feng's work, with wide potential application in the production of pharmaceuticals and other products, was also selected for the 2011 Top 10 Science and Technology Progress Awards for Chinese Universitie, as well as other national awards.

# Biological Science

The College of Life Sciences at SCU focuses on the application of biotechnology in agriculture, pharmaceutical industry, sanitation, and environment protection. Capitalizing on modern approaches and platforms, the college has made notable achievements in the classification of animals and plants, as well as system evolution, conservation and utilization of microorganism resources, protection of giant pandas and other rare species, healthy breeding of animals, mechanisms of stress resistance in plants, crop breeding, biofuel production technologies, human diseases, metabolism and ageing, as well as environmental restoration techniques.

Xiao Zhixiong, a senior scientist on the state 973 project, leads a team focusing on cancer metastasis. They studied the function and regulation of tumour suppressor proteins and contributed to a better understanding of mechanisms for preventing cancer metastasis. Research results are published in journals, such as *Oncogene*, *Cancer Cell*, and *Nature Cell Biology*.

Wang Hongning and colleagues have studied antibiotic resistant pathogenic bacteria in pigs and chickens, leading to the development of safe and effective veterinary drugs. This research, along with her study on the resource protection, development and utilization of the

## LOOKING OUT FOR A NATIONAL TREASURE

A major centre for China's panda conservation research since the 1970s, SCU has been instrumental in major field surveys on the number and habitat of these remarkable creatures.

Currently, panda research at SCU focuses on the protection of these rare animals in the wild. Under the conservation biologist, Ran Jianghong, strategies have been based around the impacts of disturbances in panda habitats. Meanwhile, zoologist, Yue Bisong, and his colleagues work on genetic relationships and diversity, and the genetic management of panda populations.

Researchers at the College of Life Sciences have also made great strides in the breeding, protection and disease control of other endangered or threatened wild animals, such as Tibetan macaques and dwarf musk deer. Specifically, Liu Jianquan's functional genomics study on yaks has contributed to advances in conservation research.

Rongchang swine breed have won national awards in science and technology. Yang Zhirong and Zhang Jie assessed the ecological value for ecotones in China and advanced key restoration and treatment technologies, which was also awarded the national prize for progress in science and technology by the Ministry of Science and Technology (MOST).

# Electronic Information Science

Established in 1998, the College of Electronic Information has quickly grown into a 121-faculty team, covering research areas of information and communication engineering, electronic science and technology, optical engineering, physical science and technology, computer science and technology, as well as control science and engineering. Its researchers are at the forefront of research on high-power solid-state laser, 3D imaging with structured illumination, and microwave chemistry, having won more than a dozen national and provincial awards.

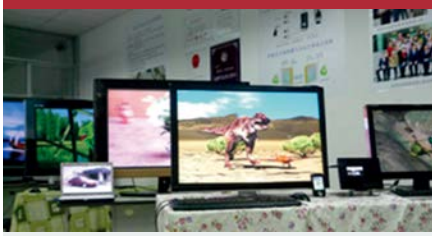
A team led by CAE academician, Zhou Shouhuan, and his colleague Feng Guoying, is dedicated to the study of micro- and nano-structured materials, with results published in *Nature Nanotechnology*, *Nano Letters* and other key international journals. They proposed doping specified impurity ions into nanocrystalline particles to form a doped-nanocrystal and have successfully fabricated, for the first time, nanowires that show strong emission at room temperature. With these nanowires as the gain medium, oscillation wavelength of 2,194 nm is achieved. The technology has potential for applications to mid-infrared lasers.

The applied electromagnetics research team, under Huang Kama, has conducted breakthrough research on the macro and micro mechanisms through which microwave accelerates chemical reactions.

They have, for the first time, identified the patterns of electromagnetic wave propagation in chemical reactions from a theoretical perspective.

The team has also discovered a new cluster structure in a DMSO-ethanol mixed solution which presents high instability under electric field, possibly causing the non-thermal effect of microwave. The research discoveries, which have been published in *The Journal of Physical Chemistry A* and *IEEE Transactions on Microwave Theory and Techniques*, will provide key evidence to the controversial issue of non-thermal effect of microwave and advance the use of microwave chemistry in industry.

## IMAGES IN THE AIR



A 3D monitor that allows users to go without 3D glasses is a result of cutting-edge technology in LCD monitors and provides a novel experience for gadget fans.

Capitalizing on their many patented technologies, SCU's Wang Qionghua and her team updated existing hardware and software to develop a high-performance no-glasses 3D monitor which exposes users to vivid-colour, high-definition and realistic displays.

Through naked eyes viewers see stereoscopic images which seem to float out of the screen and into the air. Such 3D monitors have widespread potential use in virtual reality advertising, computer games and TVs.

ENGINEERING

# Industrial-strength excellence

Engineering is a relatively new discipline at SCU. But, since its establishment in 1952, the department has gathered strength and now has 777 faculty members, including seven CAE members. Focusing on world-leading technologies, the nine engineering-related schools have become pillars of China's major industries, supplying key technologies and talent.

Built on strengths in hydraulics and mountain river engineering, polymer materials engineering, carbon capture and utilization, flue gas desulfurization, clean technology for leather manufacturing, biomedical material engineering and air traffic control automation technology, there are six state-level engineering centres or laboratories and three international collaborative research bases. These institutions have achieved a series of innovations which have brought significant economic and social benefits.

## Engineering Science and Disaster Mechanics Research Institute

The Engineering Science and Disaster Mechanics Research Institute is a multidisciplinary team of active researchers with innovative ideas. They focus on fractal rock mechanics, disaster mechanics, mechanics of deep-rock masses and its applications, underground energy storage, $CO_2$ storage in saline aquifers, and $CO_2$ -mineralization and utilization. Led by CAE academician, Xie Heping, the institute has worked on more than 60 research projects resulting in several scientific innovations.

One example is the development of a technology to generate electricity from the $CO_2$-mineralization process. Mitigating $CO_2$ emissions is a daunting challenge and Xie and his colleagues proposed a solution which transforms harmful carbon dioxide into benign or even useful products.

Combining $CO_2$ with industrial solid wastes, such as steel slag, the research group developed a $CO_2$ mineralization cell (CMC), which converts carbon dioxide into sodium bicarbonate, while simultaneously producing electricity. For every tonne of carbon dioxide, CMC can generate up to 140 kWh of electricity and 1.91 tonnes of sodium bicarbonate.

"Our $CO_2$-mineralization cell is capable of generating electricity without external energy input, the first of its kind," says Xie. "Its industrial application will bring great benefit, as it not only helps with reducing $CO_2$ emissions, but generates electricity."

The institute also studies $CO_2$ storage in saline aquifers and resource utilization. Through theoretical, experimental and data analyses, the team studied the

mechanical properties and fractal reconstruction of reservoir-specific rocks, rock deformation and seepage, including hydraulic fracturing. They proposed combining geothermal development with $CO_2$ storage in saline aquifers and established principal geological evaluation criteria for site selection. They applied the criteria to the feasibility of integrating geological storage and geothermal resource exploitation for the Shenhua Ordos CTL Project, China's first carbon capture and storage plant. It will sequester around one million tonnes of $CO_2$ annually from an existing coal-to-liquids (CTL) facility in Ordos, Inner Mongolia.

### FROM THE DEEPEST DEPTHS, A LAB AIMS HIGH

Around 500km southeast of Chengdu and 2.4km underground, is the China Jinping Underground Laboratory. Home to the China Dark Matter Experiment and the Particle and Astrophysical Xenon Detector for dark matter, it's the deepest underground laboratory in the world and the perfect site to study deep rock mechanics.

Drawing on results from the Jinping underground lab, the Engineering Science and Disaster Mechanics Research Institute plans to build a first-class, international open research platform. The institute will explore the interaction of deep-rock mechanics with seismology dynamics, innovate in-situ rock-mass testing methods and pressured coring techniques, and advance theories on in-situ rock mechanics.

By unveiling characteristics of irregular constitutive behaviours of deep rocks, their research will lay strong foundation for safe and efficient excavation of mineral resources and effective disaster prevention. Scientific quests will soon delve deep into the Earth to focus on rock masses and geological activity.

## State Key Laboratory of Hydraulics and Mountain River Engineering

Home to the world's oldest irrigation system, Dujiangyan, Chengdu has a rich history in hydraulics. It was an obvious choice when the Chinese government authorized the establishment of its first key laboratory for hydraulic engineering at SCU in 1988. The State Key Laboratory of Hydraulics and Mountain River Engineering (SKLH) specializes in hydraulics and dam engineering, dam and reservoir safety, as well as mountain river dynamics and protection. Having worked on most of the major rivers flowing through southwest China, such as the Yangtze River, the Yellow River, and Lancang River, SKLH has been part of multiple major hydraulic and hydro-power engineering projects in China and made prominent contributions to the integrated development and protection of mountain and river regions.

Flood discharge and energy dissipation technologies are crucial for high dam projects. SKLH has developed a series of new technologies and applied them to the finest high dam hydropower stations, including Jinping I and Xiluodu.

Its technology with high-water head and large discharge flow is recognised as advanced in China and around the world.

On the Jinping-II mega hydropower project, intended to generate 4,800 MW annually, SKLH has solved sediment problems with dam building. The laboratory has also performed a forecast of the impact of dam construction on river environments, monitoring and analysing stability of bank slopes and maintaining dams for key hydraulic engineering projects.

The lab team has researched the development and management of water resources, established a system of risk analysis for catastrophic mountain flash flood disasters, and studied integrated optimal regulation of cascade hydropower plants.

Over the years, SKLH has won more than a dozen national science and technology awards, obtained more than 100 domestic and international invention patents, and published hundreds of papers on high-level international journals. It has gained an international reputation by hosting the 35th World Congress of the International Association for Hydro-Environment Engineering and Research (IAHR) and establishing long-term collaborations with world-renowned research institutions.

Dujiangyan irrigation system in Chengdu

# State Key Laboratory of Polymer Materials Engineering

Supported by a World Bank loan, the State Key Laboratory of Polymer Materials Engineering (SKLPME) was set up in 1991 as one of seven national pilot laboratories under the Key Discipline Development Project. It was the first state key laboratory in polymer materials and is now one of the largest polymer research and educational bases in the world.

Geared towards frontier sciences and responding to the demands of national economic development, SKLPME's research focuses on the structure and properties of polymers, polymer-based functional composites, polymer material processing theories and related technologies and production. Its influential research results are revealed in numerous publications in high-quality international journals and have earned many national science and technology awards, as well as domestic and international patents. The laboratory ranks first globally in the polymer science discipline in terms of the number of papers published in journals listed in SCI.

SKLPME researchers are at the forefront of the revolutionary technology in polymer processing — the micro-nano laminated composite. High-performance materials in nature usually have complicated multi-layer structures. To improve polymer properties, a team led by Guo Shaoyun successfully designed an apparatus to fabricate micro-nano laminated composite materials, the first to continuously and steadily extrude polymer materials with more than 30,000 layers. "Our multi-layer composite materials have many advantages over traditional materials and wide industrial applications," says Guo. "Our research also enables a closer look at how to optimize properties of common polymer materials."

Chinese Prime Minister Li Keqiang visits the SKLPME at SCU

Other examples of SKLPME discoveries include finding how low-dimensional carbonaceous nanofiller induced polymer crystallization dynamically; developing technologies for the synthesis of styrenic thermoplastic elastomer and related products; inventing a device that enables in-process morphology control of the polymer injection moulding; and advancing plastic tubing extrusion technologies. Many of the SKLPME technologies are translated into lucrative products, such as the world-leading graphene rubber composites and tyres, China's first blood dialyzer based on polyether sulphone (PES) and new technology for complete sets of lithium battery diaphragm.

SKLPME has also collaborated with institutions in the United Kingdom, Canada, the United States and many countries in Europe to conduct research on polymer processing and develop high-performance polymer materials. The construction of four international collaborative research platforms has raised its international profile, making it a global centre for polymer material research, integrating discovery, student training and technological applications.

# National Engineering Laboratory for Clean Technology of Leather Manufacturing

China has seen steady growth of its leather industry since 1995 and is the largest leather producer in the world. Leather science research has evolved to support this vital sector. In 2008 the National Engineering Laboratory for Clean Technology of Leather Manufacturing was established at SCU, to coordinate environmentally sustainable development of the leather industry through science and technology.

Leather science has been studied at SCU since 1921. With the establishment of the national engineering laboratory, the university plays a leading role in the development of leather science in China. Integrating advanced technologies with traditional tanning techniques, the laboratory has conducted much original research on the design and manufacture of functional leather, bringing the benefits

of the latest knowledge to a thousand-year-old industry.

One such advance is the laboratory's work on the design and manufacture of ultra-wideband electromagnetic (EM) shielding leather. Leather materials can normally absorb low frequency EM waves in the range of 10-500 MHz, making it an ideal material for microwave-absorptive substrate. Coating leather surface with a low-dimensional conductive nanomaterial, Shi Bi, an academician of the CAE and the laboratory's director, along with his research team prepared a material with high-performance shielding ability in a broad frequency range (10 MHz-12 GHz).

Under the process, some EM waves are first reflected by the conductive layer consisted of nanomaterials, then when passing through the conductive layer, they decay and are transformed to low-frequency EM waves absorbable by the leather substrate. Ultra-wideband EM shielding is achieved through the high reflectivity and absorption capacity of the nanocomposite leather material.

"This high-performance shielding material is lightweight and can be tailored into wearable clothing," says Shi. "It has great potential for applications in human body EM shielding, precision instruments immune to EM interference and EM signal blocking."

The laboratory also fabricated super-hydrophobic and scratch-resistant leather by applying nanotechnology in the surface modification of collagen nanofibres in the material's hierarchically fibrous structure. When scratched, the nano structure in the specially-treated material will automatically repair the destroyed hydrophobic structure, resulting in "in-situ self-repair". This super-hydrophobic leather material could be used to make outdoor products and self-cleaning clothes.

Shi Bi speaks at the IULTCS conference

The lab's research has won global recognition for China's leather industry. Shi was elected the president of the International Union of Leather Technologists and Chemists Society (IULTCS) in 2010 and won the IULTCS Merit Award in 2015 for the extraordinary impact of his work.

## National Engineering Research Center for Biomaterials

Biomaterials engineering is a burgeoning interdisciplinary science, combining biology, medicine, material sciences and engineering. Strong growth in the field led to the establishment of the National Engineering Research Center for Biomaterials (NERCB) in 1999, with MOST authorization.

NERCB is the first national institute dedicated to the development of biomaterials. It specializes in research on biomaterials for tissue regeneration and function reconstruction, and medical implants. It has formed a cross-disciplinary team of innovators, including world-leading experts and ambitious young scientists.

One leader of the NERCB, Zhang Xingdong, academician of the CAE, is an internationally renowned expert on regenerative biomaterials. He pioneered research in China on bioactive ceramics and was one of the first in the world to demonstrate that lifeless calcium phosphate ceramics can induce bone regeneration. He and his team pioneered the application of tissue inducing biomaterials in bone and cartilage tissue engineering, with the development of a series of biomaterial products.


Zhang Xingdong selected as a foreign member of the US National Academy of Engineering

In recognition of his contributions, the US National Academy of Engineering elected Zhang as a foreign member in 2014. Zhang's election as the president of the International Union of Societies for Biomaterials Science and Engineering (IUSBSE) in May 2016 is another demonstration of NERCB's growing international reputation and the strong growth of China's biomaterial research.

Under Zhang's excellent academic leadership, NERCB has published more than 500 papers in peer-reviewed international journals, won two dozen national and provincial science and technology awards, and obtained more than 70 patents. It has carried out significant exchange and collaboration with international universities and research institutes and has organized many meetings on biomaterials. NERCB is China's conduit for exchange on biomaterial research, promoting growth of the field.

MEDICAL SCIENCE

# At the pulse of a healthy nation

The West China Medical Center of SCU is the cradle of China's modern medical education and is highly regarded nationally and throughout the world.

Formerly West China University of Medical Sciences, the centre's origins are in the West China Union University which was jointly founded by five Western Christian Missions in 1910. Since being merged with the former SCU in 2000, this comprehensive institution has rapidly developed to reach the pinnacle of medical education, research and care. It is now a model for the nation in higher education for medical sciences, an innovation platform in research, and a hub for collaborative medical, pharmaceutical and healthcare services, providing diagnosis and treatment for difficult and acute cases, as well as emergency medical attention.

The 1,100-mu (181 acres) centre has six colleges covering a range of disciplines: clinical medicine, stomatology, preclinical and forensic medicine, public health, pharmacy, and nursing. In total there are more than 10,000 faculty and staff, including 587 full professors and 750 associate professors. They are training around 8,000 health professionals and biomedical researchers — 45% at doctoral or master's level, and 400 international students.

The medical centre has four affiliated teaching hospitals: West China Hospital, West China Women's and Children's Hospital, West China Stomatology Hospital and No.4 West China Teaching Hospital. They offer advanced services and fulfil important social responsibilities. With a total of 5,630 beds, 325 dental units and more than 9,700 health practitioners, these hospitals received nearly 7.7 million outpatients and 250,000 inpatients in 2015. Their teams conduct around 16,000 operations annually. Housed in the Women's and Children's Hospital, the birth defects monitoring

## WEST CHINA HOSPITAL: THE FINEST MEDICAL RESEARCH, TRAINING AND CARE

The West China Hospital is the region's largest, with 4,300 beds, and at the forefront of Chinese medicine. It has topped China's Best Hospitals ranking in terms of research strength and been second in general strength for six consecutive years. As a national demonstration site for clinical skills training, the hospital is a national training base for examiners of the medical licensing examination. It is also the base for medical science innovation, housing the State Key Laboratory of Biotherapy, along with other research centres, such as those on precision medicine, neuro science, evidence-based medicine and clinical pharmacy research. The hospital is the country's leader in living donor liver transplantation, interventional cardiology, minimally invasive surgery for gastric lung cancer and gastric diseases, clinical anaesthesia, as well as imaging and nuclear medicine.

Through tele-medicine technology, the hospital has networked with more than 700 grass-roots hospitals in the region, providing remote medical consultation and distance-education to help build capacity of local hospitals.

centre is China's only national institution for maternal and child health surveillance. It provides monitoring data about 140 million people around the country to support health policy-making.

High-quality medical care is underpinned by strong research capacities at the West China Medical Center. It excels in research on protein molecular structure and function for major diseases, frontier neural science and brain functions, prevention and treatment of infectious diseases, reproductive development, precision medicine for major diseases, and regenerative repair with the use of stem cells and biomaterials. Its clinical medicine, pharmacology and toxicology, biology and biochemistry, neuroscience and behavioural science, molecular biology and genetics are ranked among the top global 1% according to the ESI. In the last five years, the centre has published more than 7,000 papers in international journals, received around 1.75 billion RMB funding support, and has received 80 science and technology awards from state and local governments.

The centre is home to three national key laboratories or engineering centres, 23 ministerial and provincial laboratories, and is a leading institution for the national 2011 Collaborative Innovation Project. It is currently undertaking a large-scale national project for major infrastructure building for biotherapy and translational medicine.


# Improving treatment via biotherapy

Biotherapy is the fighting of disease by stimulating or restoring immune capabilities and is at the cutting-edge of cancer treatment. It is seen as having great potential as a finely-targeted approach with alleviated side-effects.

The Chinese government has invested nearly 0.9 billion RMB to build state-of-the-art infrastructure for biotherapy research and translational medicine and the West China Medical Center at SCU has been selected as the site for this national project.

This initiative aims to establish a highly integrated, complete technology chain, linking basic to clinical research, providing a world-class platform to support prompt translation of research on biotherapy and regenerative medicine.

The construction includes three research platforms, covering screening and preparation of biological products, as well as translational clinical studies. Major infrastructure building will allow for: systematic and large-scale research on the genesis, development, prognosis and treatment of major diseases; high-throughput research on biotherapy and large-scale preparation of regenerative medical products; and rapid translation of biotherapeutic products and approaches to the clinic.

## STATE KEY LABORATORY OF BIOTHERAPY

Established in 2005 by MOST, the State Key Laboratory of Biotherapy (SKLB) is a comprehensive and multidisciplinary research centre, aiming to improve the treatment of major diseases such as cancer, cardiovascular diseases, obesity, diabetes, infectious diseases, inflammatory diseases, neurological disease, as well as chronic autoimmune diseases.

It was selected as one of the National Research and Development (R&D) Platforms for Novel Drugs in 2008 and became the site for the National Collaborative Innovation Center for Biotherapy in 2013.

SKLB's 100-plus researchers are studying gene and cell therapy, vaccines, monoclonal antibodies, recombinant proteins, and synthetic small molecules and natural products for drug discovery. Their work has yielded more than 500 research papers every year in peer-viewed journals, including *Nature, Nature Medicine, New England Journal of Medicine, Developmental Cell* and *Molecular Cell*.

Taking advantage of the rich clinical resources of West China Hospital, SKLB has seamlessly integrated basic research and preclinical development with translational and clinical medicine. With an efficient and integrated technology chain for the discovery and development of innovative drug candidates, SKLB has, to date, licensed more than 50 patents in China and transferred 45 potent candidate drugs for commercial development.

The 80,000-square-metre laboratory is still expanding. The National Translational Medicine Center for Biotherapy, due to open in 2019, will more than double SKLB's research space and facilitate the translation of basic research from bench to bed.

# From strong roots, a leader in dental science

Emerging from the Renji Dental Clinic which was founded in 1907, the West China Hospital of Stomatology was China's first dental hospital. Built within the hospital, the nation's first dental school was established in 1917 under West China Union University. The school was renamed West China School of Stomatology after the merge with SCU.

West China School of Stomatology combines dental education, research and clinical care. Encompassing the affiliated dental hospital, the school has 798 faculty and staff, including 82 professors and 122 associate professors. Its clinical stomatology and basic science of stomatology courses are highly rated nationally. In evaluations by MOE, the stomatology programme was rated the best in the country, having nurtured many of China's leading scholars and educators in dental sciences.

With a state key laboratory of oral diseases, China's first engineering laboratory for oral regenerative medicine and a MOE-sponsored engineering research centre of oral translational medicine, the school has established high-quality platforms for basic research and applied science. Major research areas cover the mechanisms and treatment of oral infections, technologies for restoring missing teeth and tooth decay, causes of congenital maxillofacial deformity, and oral mucosal cancer and its metastasis. The school publishes more than 200 papers annually in international journals and is ranked first among dental schools in the nation in terms of journal publications and number of citations.

Its affiliate, West China Hospital of Stomatology, is one of China's top dental hospitals, specializing in cariology and endodontics, periodontics, oral mucosal disease, oral maxillofacial surgery, orthodontics, prosthodontics, dental implant and paediatric dentistry. The hospital treats more than 700,000 outpatients, receives 5,400 inpatients and conducts 4,300 operations annually, providing a full range of sophisticated diagnostic and therapeutic services.

## STATE KEY LABORATORY OF ORAL DISEASES

The State Key Laboratory of Oral Disease (SKLOD) has its origin in the Dental Research Department of West China Union University which was established in 1936. It was designated a national key laboratory in 2007 by MOST.

With a focus on mechanisms of major oral diseases and techniques for clinical prevention and treatment, SKLOD has a strong team of researchers working on multidisciplinary projects and can boast prominent research achievements. According to statistics on international publications in the field of stomatology, SKLOD was ranked the first in China for five consecutive years, either in terms of article count, number of citations and number of highly-cited papers.

With goals of becoming a leading international laboratory, SKLOD is an active player in exchanges with domestic and international institutions. Its founding of the *International Journal of Oral Science* in 2009 is testament to SKLOD's dedication to academic exchange. This English-language journal was included in the database of Science Citation Index Expanded (SCIE) and PubMed (MEDLINE) in 2010, becoming China's first SCI-listed journal in dental sciences.

In 2013, the laboratory founded another English-language journal, *Bone Research*, listed in SCI in 2014. Both journals have the highest impact factors in their relative disciplines in Asia. A designated national base for global collaboration, SKLOD is a bridge that links China with the world's top dental research centres.

# University snapshot is a picture of health

**West China School of Public Health** is a key base for public health research and talent training in the country. The school leads nutrition and food security research in China, having pioneered a public health laboratory sciences training programme. Carrying forward the heritage of its former professor, Chen Zhiqian (Dr. C. C. Chen), an eminent national public health leader, the school actively promotes his primary health care ethos. Integrating prevention and treatment, it also has an affiliated hospital specializing in the prevention and control of occupational diseases — the only one in China.

**West China College of Preclinical and Forensic Medicine** was established in 2001 through the melding of the basic medicine and forensic medicine schools. The school exposes graduate students to international research collaboration opportunities, resulting in high-quality doctoral dissertations. One doctoral student, He Xuelian, published her work on the molecular mechanism of medulloblastoma in *Nature Medicine*. The study identified a potent suppressor of this malignant brain tumour common among children, showing the potential of using G protein modulation for effective target therapy.

The forensics programme focuses on using genetic markers for personal identification and paternity testing. Exploration of new technologies has led to breakthroughs in the typing of degraded and trace DNA and the analysis of difficult samples. Particularly, advancement has been made in the analysis of Y chromosomes and mixed stains.

**West China School of Pharmacy** is one of the oldest in China and has contributed to novel drug discovery in the country. The school has made significant achievements in research on anti-tumour drugs, natural active agents, targeted drug delivery systems, drug stabilization and chemical sensors.

Research results include: identifying the structure of hormone alphal in Phytophthora mould, a world first, contributing to the discovery of drugs to combat these destructive microorganisms. Another study has constructed complex chiral cyclic compounds with development in asymmetric catalysis, and yet another led to the development of a solid lipid nanoparticle system that delivers a key regulator of tumour suppression, opening the door for clinical application of nucleic acid drugs in cancer stem cell therapy. The school's research results were published in journals, including *Nature Chemical Biology* and *Angew. Chem. Int. Ed. Engl.*

**West China School of Nursing** was among the first Chinese higher education institutions to offer nursing training, and among the first authorized by the state to offer doctoral degrees and postdoctoral training in nursing. Its programme is ranked second in the country in a MOE evaluation.

With more than a dozen ministerial and provincial key laboratories, the school is also a base for nursing research. Major research areas cover evidence-based clinical nursing, nursing administration, old-age nursing, disaster nursing and management of chronic diseases.

## THE PIONEER OF MATERNAL AND CHILD MEDICINE

West China Women's and Children's Hospital, under the immediate supervision of the Chinese Ministry of Health, is China's top tertiary hospital for women and children. Its ob-gyn and paediatrics programmes are both rated as National Key Disciplines. As the diagnosis and treatment centre for difficult and critical illnesses in Southwest China, the hospital is the regional collaborative centre for leukaemia and congenital heart diseases of rural children.

West China Maternal and Children's Medical Research Institute is the research arm of the hospital. Focusing on women and children's health, it has published papers on top international journals, such as *Lancet*, *Cell*, and *Nature Medicine*.

HUMANITIES AND SOCIAL SCIENCES

# Halls of enlightenment

Humanities and social sciences are an honoured tradition and historic strength for SCU. Several key figures in China's liberal arts history have either taught or conducted research at the institution.

There are 10 colleges and more than 1,200 faculty members engaged with humanities and social sciences teaching and research, including 308 full professors, 445 associate professors and 16 MOE-sponsored Yangtze River Scholars. Subject areas include literature, history, philosophy, economics, management, law, international studies, education and arts. There are four MOE key bases for humanities and social sciences, along with two collaborative innovation centres, focusing on borderland and multi-ethnic cultural agglomeration studies.

Between 2011 and 2015, the colleges and research institutes have undertaken 218 projects supported by the National Social Science Foundation of China and 160 MOE-sponsored projects, receiving funding support of 54 million RMB and 30 million RMB respectively. These prominent projects led to nine books selected for the national philosophy and social science achievement collections, dozens of awards from MOE for excellent social science research, and a series of publications in domestic and international peer-reviewed journals.

## Research from religion to relics

Years of exhaustive research have seen SCU achieve a series of remarkable academic results in humanities.

- The compilation of *A History of Chinese Daoism and A History of Chinese Daoist Thought*, both led by the renowned scholar, Qing Xitai, have bridged a gap in religious research, reinforcing SCU's status as a leader in Daoism studies.
- Xiang Chu, of the College of Literature and Journalism, has led a group of SCU scholars in exploring the relics from the Dunhuang caves and delved deep into Dunhuang literature, grotto-arts and history, linguistics, philology and Buddhism. Their findings add weight to China's role as a world centre of Dunhuang studies.
- *The Complete Works of Song Dynasty*, a team effort, is one of China's largest collections on dynastic research and has been acclaimed by Japanese scholars having "ushered in a new era".
- The compilation of *The Confucianism*, *The Chinese Dictionary*, and *Dictionary of Oracle-bone Characters* by SCU scholars are all milestone works in humanities and liberal arts studies.

SCU is an authority on Chinese Tibetan studies, South Asia studies, and Chinese western development strategies. It also excels in American and European studies. Research findings have gained acclaim in the international research community and have been used in policy decision-making.

In other areas, the School of Public Administration has translated its research findings into public policy and system innovations, providing effective new models for local governance. Researchers from the business school have conducted in-depth analysis on multi-stage, multi-level and multi-purpose decision-making in uncertain environments and published a series of books on the subject with the international publisher, Springer. The College of Literature and Journalism has undertaken pioneering studies on comparative literature and poetry. The law school specializes in criminal application, and has contributed to the refinement of criminal procedure codes in China.

PRESIDENT'S ADDRESS

# A beacon of excellence: Future agenda for Sichuan University

**Xie Heping**
President of Sichuan University, Academician of the Chinese Academy of Engineering

Universities are the lighthouses of human civilization and serve as fundamental engines for social and economic development. As one of China's earliest modern universities, Sichuan University, founded in 1896, has consistently embodied the ideals of embracing all schools of thought, cultivating pillars of the country, promoting academic progress, directing social development and working for the wellbeing of humankind. Our university has made significant contributions to China's socioeconomic development, as well as to the broader advancement of human civilization at various stages of its history.

As we mark our 120th anniversary, Sichuan University is at a turning point. We have impressive academic strengths across disciplines, including medicine, biological sciences, basic and applied sciences, engineering, social sciences, arts and humanities. We are fortunate to be located in a very dynamic region of China, and to enjoy close relationships with creative governmental partners --- at the national, provincial and municipal levels. We also benefit from deep and multi-faceted partnerships with the industry, as well as an incredibly well-connected and dynamic alumni network. But we face multiple challenges too. As the world is changing rapidly, we need to fundamentally transform our research and educational models if we are to serve our students and society more effectively in the next 120 years.

Our fundamental strategy for the future is to more effectively integrate our research, education and public service missions. We are developing new models for multidisciplinary, multisectoral and multinational collaborations, with a focus on innovation. We envision a future in which our professors and students are increasingly engaged in collaborating with multiple sectors of society and with partners worldwide, on concrete projects that address fundamental challenges facing humanity.

**" Our fundamental strategy for the future is to more effectively integrate our research, education and public service missions. "**

Moving to such a project-based approach, which diversifies from the traditional classroom-based models of knowledge transmission, will require enormous changes in all aspects of the university's administration. But the ultimate benefit will also be enormous; it will enable us to make greater contributions to society and enlarge Sichuan University's leadership role worldwide in the next 120 years.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