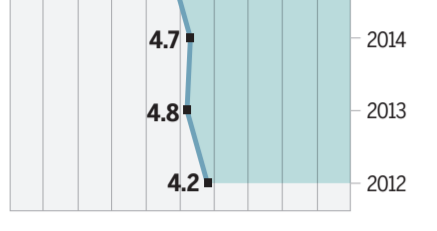
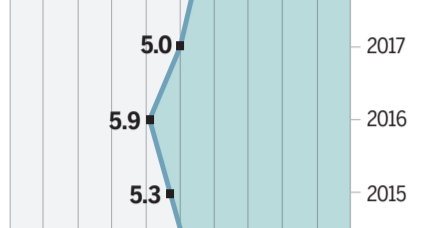
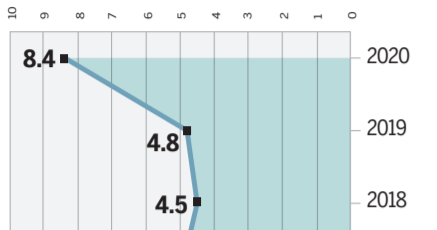
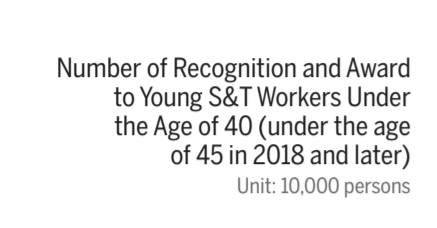
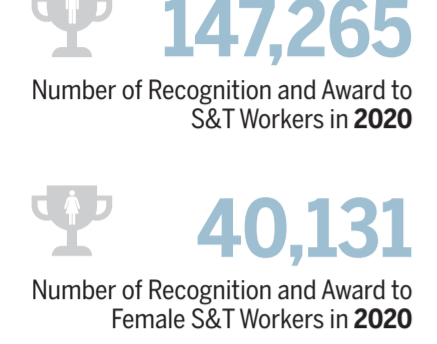
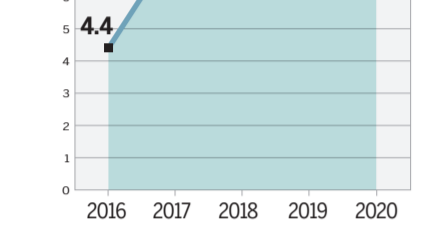
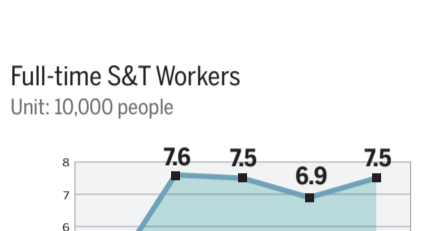


SERVICES FOR THE SCIENTIFIC AND TECHNOLOGICAL WORKERS



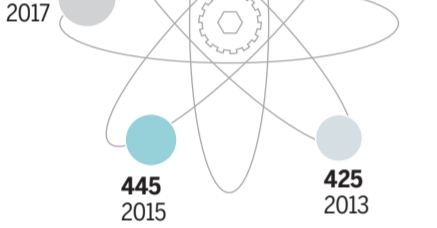
S&T POPULARIZATION ACTIVITIES



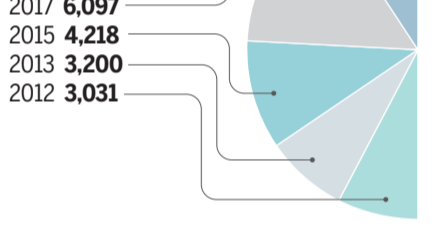
SURVEY ON CHINESE POPULATION'S SCIENTIFIC LITERACY



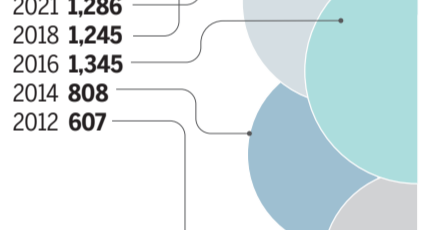
ACADEMIC EXCHANGES



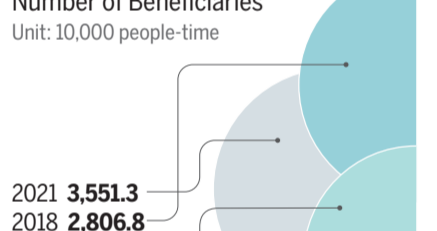
OPENNESS AND COMMUNICATION ACTIVITY ON TECHNOLOGY



Types of S&T Journals



Experts in International Nongovernmental S&T Organizations in 2020



Source: Statistics Yearbook, The Annual Business Report, The Development of CAST, Nongovernmental S&T Organizations

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# CHINA TO PROMOTE WIDESPREAD INNOVATION FOCUSED ON SCIENCE AND TECHNOLOGY

Country is celebrating remarkable achievements in those fields

**MARS ROVER ZHURONG**  
Zhurong is China's first Mars rover. On May 22, 2021, the Zhurong rover arrived on the surface of Mars and began its exploration. As of May 5, the Zhurong rover has worked for 347 Martian days and has traveled a total of 1,924 meters.

**MICIUS QUANTUM COMMUNICATION SATELLITE**  
Micius is the world's first space quantum science experimental satellite. Launched in 2016, the satellite has conducted many experiments in basic sciences related to quantum entanglement and quantum mechanics.

**TIANGONG SPACE STATION**  
Tiangong Space Station is a national level space laboratory assembled in orbit with multiple modules. It is used to carry out large-scale space science and technology experiments that require long-term human participation. The space station is expected to finish construction around 2022.

**YUTU 2 LUNAR ROVER**  
The Yutu 2 lunar rover landed on the far side of the moon on Jan. 3, 2019. It's the first lunar rover to set foot on the dark side of the moon. As of Jan. 6, the Yutu 2 lunar rover had traveled 1,003.9 meters, and it is still exploring the unknown region.

**DARK MATTER PARTICLE EXPLORER WUKONG**  
Wukong is China's first space astronomical satellite. Launched in 2015, it aims to discover and study dark matter, an invisible substance that does not interact with the electromagnetic force yet makes up about 25 percent of the universe.

**SGDSAT1**  
The world's first scientific satellite dedicated to serve the United Nations 2030 Agenda for Sustainable Development. Launched in 2021, the satellite will provide data support for the evaluation and research of multiple indicators for the sustainable development goals.

**SCIENTIFICALLY AND TECHNOLOGICALLY LEADING COMPANIES**  
Scientifically and technologically leading companies and new-type research and development institutions should be expanded and become the pillars in industrial reforms.

**INDUSTRIAL REFORMS**  
It is necessary to gather strategies, plans and policy resources to support scientific and technological self-reliance and self-improvement. It's also necessary to help companies to innovate by offering them guidance and establishing platforms for them.

**UPSTREAM AND DOWNSTREAM COMPANIES**  
The industrial and supply chains are designed to be controllable. Cooperation between enterprises and universities should be furthered to develop safe and reliable innovation chains with strong capacities to deal with emergencies and changes.

**COOPERATION BETWEEN COMPANIES**  
Upstream and downstream companies can enjoy closer partnerships in terms of innovation and cooperate to increase their capabilities of coping with risks.

**COMPREHENSIVE ENHANCEMENT**  
It is necessary to comprehensively enhance the systematization of scientific and technological innovation to guarantee scientific and technological self-reliance and self-improvement.

**NEW RELATIONSHIPS**  
New relationships among companies, universities and research institutions should be promoted. It is necessary to systematically decide major tasks and also to organize and implement major projects to efficiently utilize professional, technological and capital.

**EFFICIENCY OF RESEARCH**  
It is possible to enhance the efficiency of both scientific research and innovation activities to advance systematization of scientific and technological innovation.

**ADVANCED RESEARCH**  
High-level research-type universities can perform their functions as social innovation incubators while national scientific and technological institutes should highlight their leading role in cutting-edge fields.



**CS19 PASSENGER JET**  
The CS19 is China's first narrow-body airline. The plane is designed to seat around 150 to 170 passengers, and it made its maiden flight in May 2017.

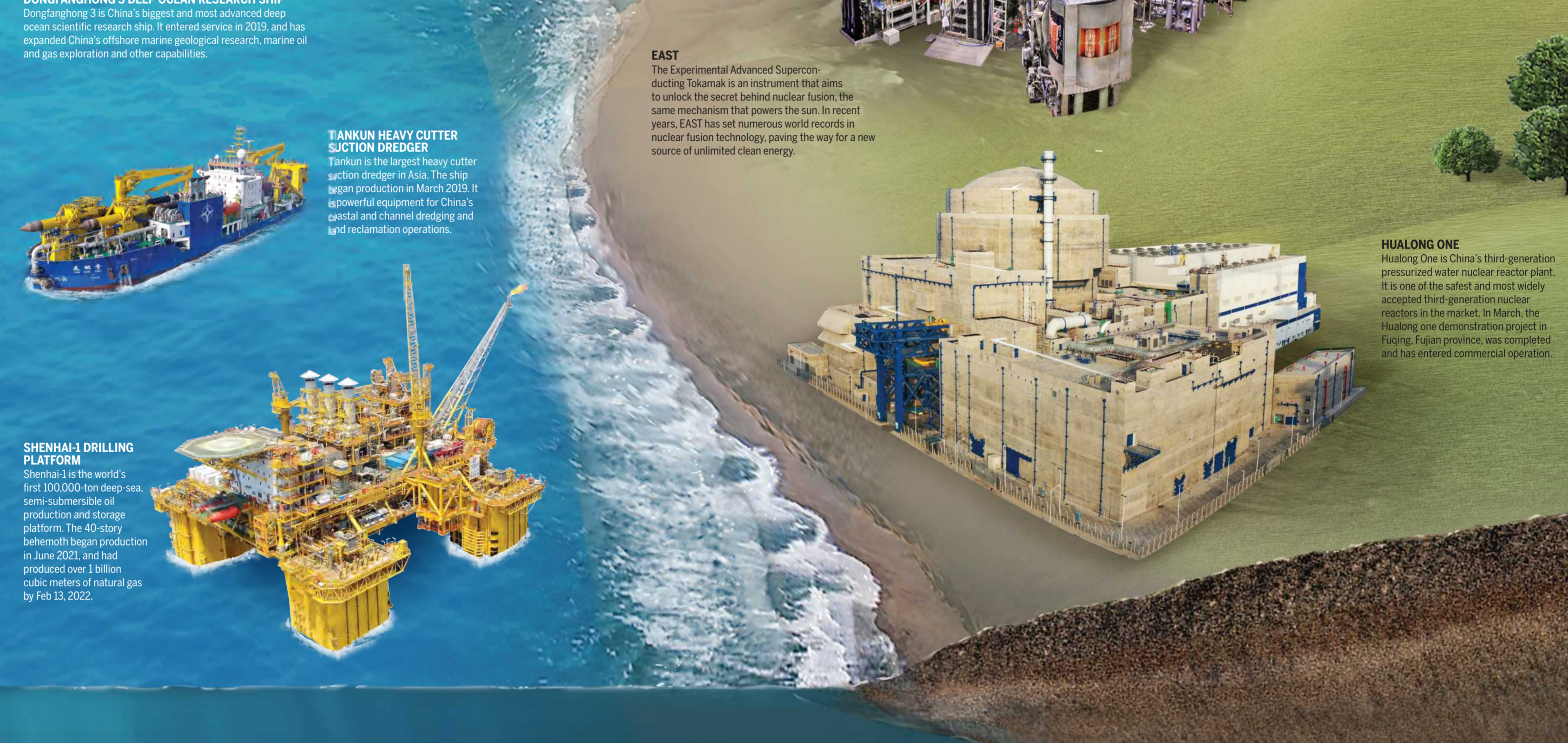
**XUELONG 2 ICEBREAKER RESEARCH VESSEL**  
Xuelong 2 is China's first advanced polar research expedition vessel that entered service in 2019. It is set to expand scientific knowledge on the natural conditions of the South and North poles.

**FAST**  
The five-hundred-meter Aperture Spherical Telescope is the largest single-dish radio telescope in the world. Located in Pingtang county, Guizhou province, the telescope finished construction in 2016, began operation in 2020 and has been opened to the global scientific community since 2021.

**DONGFANGHONG 3 DEEP OCEAN RESEARCH SHIP**  
Dongfanghong 3 is China's biggest and most advanced deep ocean scientific research vessel. It entered service in 2019, and has expanded China's offshore marine geological research, marine oil and gas exploration and other capabilities.

**FIXING BULLET TRAINS**  
The Fixing Bullet Trains family of high-speed electric multiple unit trains developed by China. It has a top speed of around 350 kilometers per hour and was put into use in 2017. As of the end of 2021, the Fixing Bullet trains had operated safely for 1.26 billion km and transported 1.37 billion passengers.

**HUALONG ONE**  
Hualong One is China's third-generation pressurized water nuclear reactor plant. It is one of the safest and most widely accepted third-generation nuclear reactors in the market. In March, the Hualong One demonstration project in Fuxing, Fujian province, was completed and has entered commercial operation.



# Chinese science and technology combat global issues

**TANJUN HEAVY CUTTER**  
Tanjun is the largest heavy cutter section dredger in Asia. The ship began production in March 2012. It is powerful equipment for China's coastal and channel dredging and land reclamation operations.

**SHENHAI 1 DRILLING PLATFORM**  
Shenhai 1 is the world's first 3,000-ton deep-sea, semi-submersible oil production and storage platform. The 40-story behemoth began production in June 2011, and had produced over 1 billion cubic meters of natural gas by Feb. 13, 2022.

**SHENHAI YONGSHI MANNED SUBMERSIBLE**  
Shenhai Yongshi (Deep-sea Warrior) is a manned submersible designed to operate around 4,500 meter depths. It entered service in 2017 and has carried out numerous missions to study ocean resource exploration, geochemistry research and marine biology.

**HAIYI UNDERWATER GLIDER**  
Haiyi is a series of underwater gliders that has an operating depth ranging from 300 meters to 7,000 meters. In 2017, Haiyi dove 6,592 meters, setting a new world record for underwater glider diving depth.

**WORLD'S MOST ADVANCED DEEP OCEAN SCIENTIFIC RESEARCH VESSEL**  
The world in its relevant research and helped some developing countries and vulnerable groups get vaccines and medicine at lower costs. Since the Chinese government announced that it would peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060, China has taken many initiatives and put in substantial efforts to pursue the goals.

**RENEWABLE ENERGY**  
In recent years, technological innovations have played a key role in China's energy field with new achievements continuously emerging. China's ultra-supercritical coal-fired power generation and ultrahigh-voltage power transmission technology achieved a world leading level.

**NUCLEAR POWER**  
Nuclear power projects, such as Hualong One technology — China's domestically developed third-generation reactor — are also a crucial step in this effort.

**RENEWABLE ENERGY**  
The utilization scale of renewable energy in China ranked top across the globe. By the end of 2020, the cumulative installed capacity of renewable energy in China accounted for about one-third of the total installed capacity in the world.

**HYDROGEN, WIND AND SOLAR**  
Among them, the cumulative installed capacity of hydrogen, wind power and photovoltaic power generation all ranked first in the world, providing strong support for the utilization of clean and low-carbon energy.

**ACCELERATING DEVELOPMENT**  
Accelerating the development of new energy vehicles is also a key path to move towards the goal of carbon neutrality. In 2021, the global market of new energy vehicles maintained rapid growth. The sales volume of new energy vehicles in China exceeded 5 million for the year.

**2021 WORLD NEW ENERGY VEHICLE CONGRESS**  
The 2021 World New Energy Vehicle Congress, authorized enterprises from 15 countries established the "Hainan consensus" which advocated the green and low-carbon development of the whole life cycle and the whole industrial chain of new energy vehicles through low-carbon energy supply, low-carbon material supply, low-carbon production process and low-carbon transportation.

**CLIMATE CHANGE**  
While dealing with global climate change, land desertification has also become an increasing concern. As a major force in leading desertification around the globe, China has adhered to the principle of "ecology and green development are the priority" and made every effort to solve land desertification over the decades.

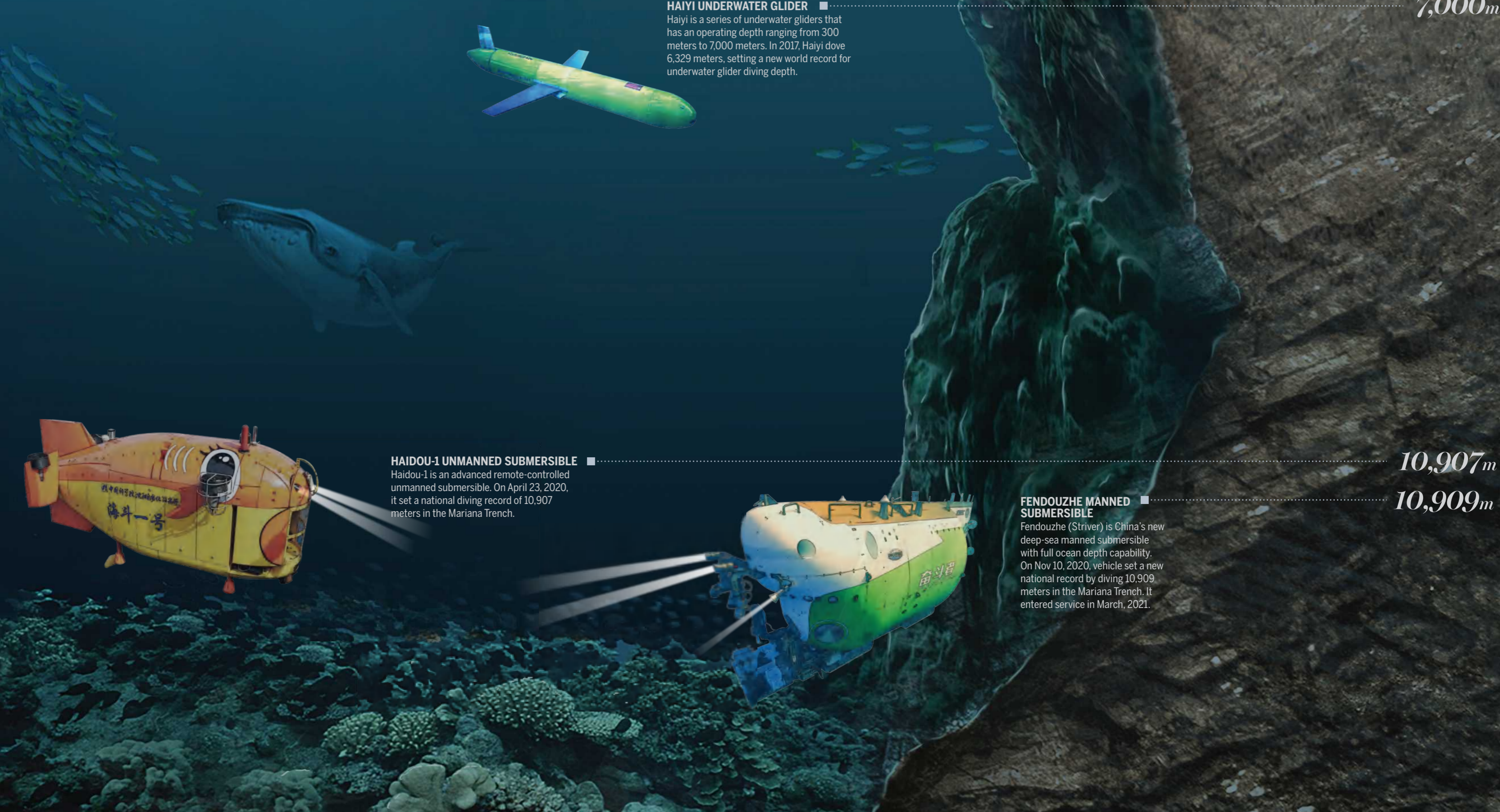
**INTERNATIONAL COOPERATION**  
International collaboration on science and technology is also a significant component of the Belt and Road Initiative which takes cultural exchanges and people's connections across the globe as a main subject. Wan said.

**FRAMEWORK OF BRI**  
Under the framework of the BRI, China has adhered to the principle of peace and cooperation, openness and inclusiveness, to pursue mutual benefits and win-win results. With full respect for the development targets of BRI countries and regions, China carried out scientific and cultural exchange projects, constructed jointly managed laboratories, set up science and technology industrial parks and guided better commercialization of research results, Wan said.

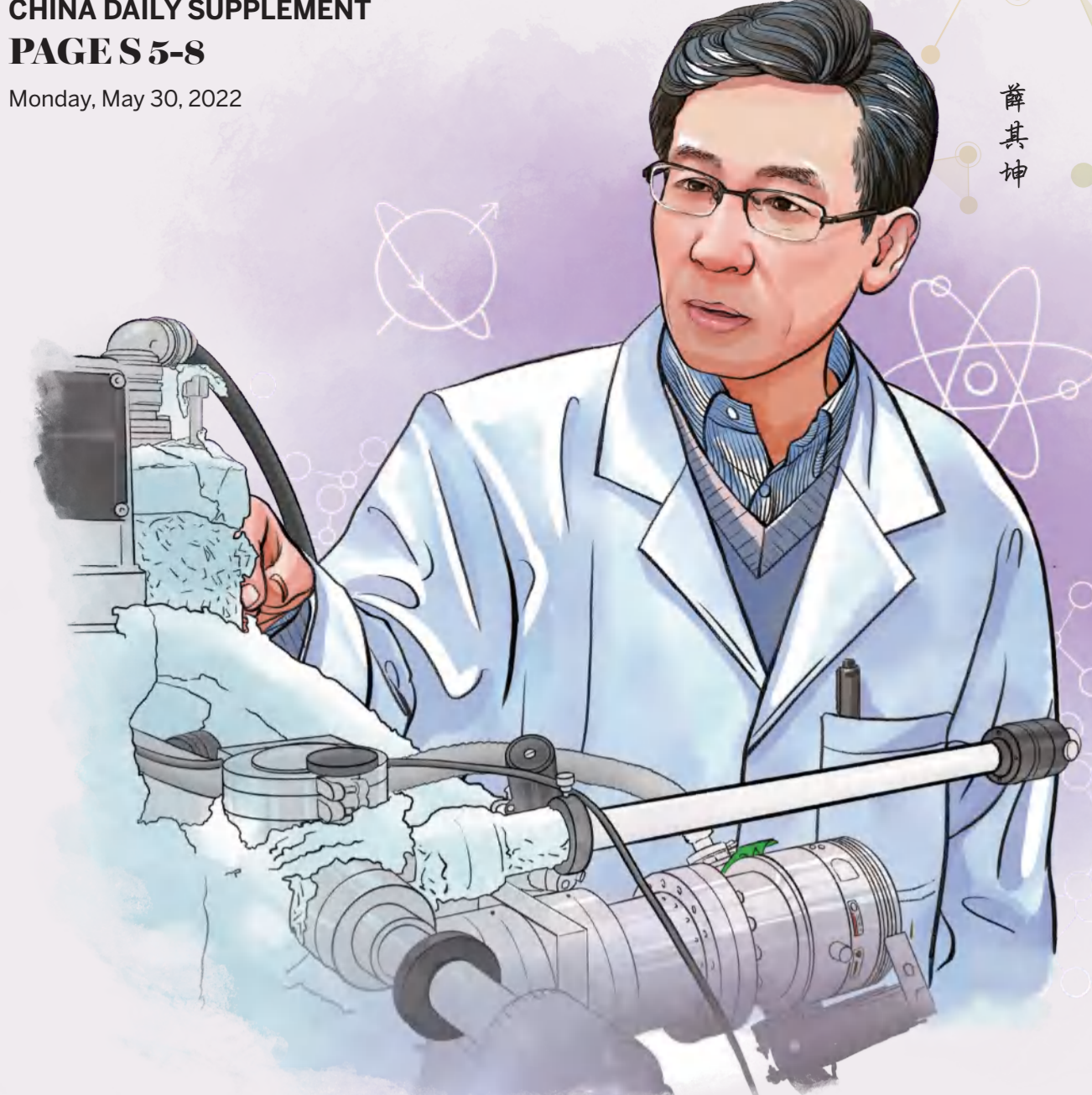
**SHARED FUTURE**  
Under the principle of building a community with a shared future for mankind, China held fast to the global vision and built up its

**HAIDOU1 UNMANNED SUBMERSIBLE**  
Haidou 1 is an advanced remote-controlled unmanned submersible. On April 23, 2020, it set a national diving record of 10,507 meters in the Mariana Trench.

**FENDOUZHE MANNED SUBMERSIBLE**  
Fendouzhe (Stiver) is China's new deep-sea manned submersible with full ocean depth capability. On Nov. 10, 2020, vehicle set a new national record by diving 10,909 meters in the Mariana Trench. It entered service in March, 2021.







**Cai Tao, 40**

For Cai Tao, an associate researcher with the Tianjin Institute of Industrial Biotechnology at the Chinese Academy of Sciences, blue is not a color associated with sadness, but with hope and success. For over six years, his team focused on a single task: how to synthesize starch in a way that is similar to the process in plants, but do it much faster. Unlocking this insight is key to sustainability on Earth and future space exploration as it theoretically allows scientists to recycle carbon dioxide and turn this common industrial byproduct and greenhouse gas into food. With the aid of supercomputing and clever bioengineering, Cai streamlined the complex natural starch-making process via photosynthesis into 11 steps, with the final product being starch, whose solution turns blue upon contact with iodine.

"On July 24, 2018, our solution turned light blue for the first time after hundreds of failed experiments. It was a great moment of introspection and awe," he said. "We overcame countless difficulties over the years, and for us that light blue in a tube shone like a bright ray of hope."

Cai's findings were published in the *Journal of Science*, the Ministry of Science and Technology, the Chinese Academy of Sciences, and the China Union of Life Science Societies at the China Association for Science and Technology unanimously named it one of China's biggest original breakthroughs in basic sciences last year.

Reflecting on his achievement, Cai said maintaining curiosity, bravely forging a new path, and having the perseverance to push through the rigorous and monotonous work are the keys to success for young scientists. Aligning personal research interest with the major strategic needs of the country and the most challenging scientific questions will generate enormous passion and energy crucial for making original breakthroughs, he said. "I hope new young scientists, including myself, can keep calm and remain focused on solving the basic scientific challenges behind our country's needs and make our mark on China's path toward achieving self-sufficiency in science and technology," he added.

The new technique was published in the *Journal of Science* and would revolutionize agriculture if proven to be economically viable at the industrial level. The research was named one of China's top 10 scientific advances last year by the High-tech Research and Development Center of the Ministry of Science and Technology.

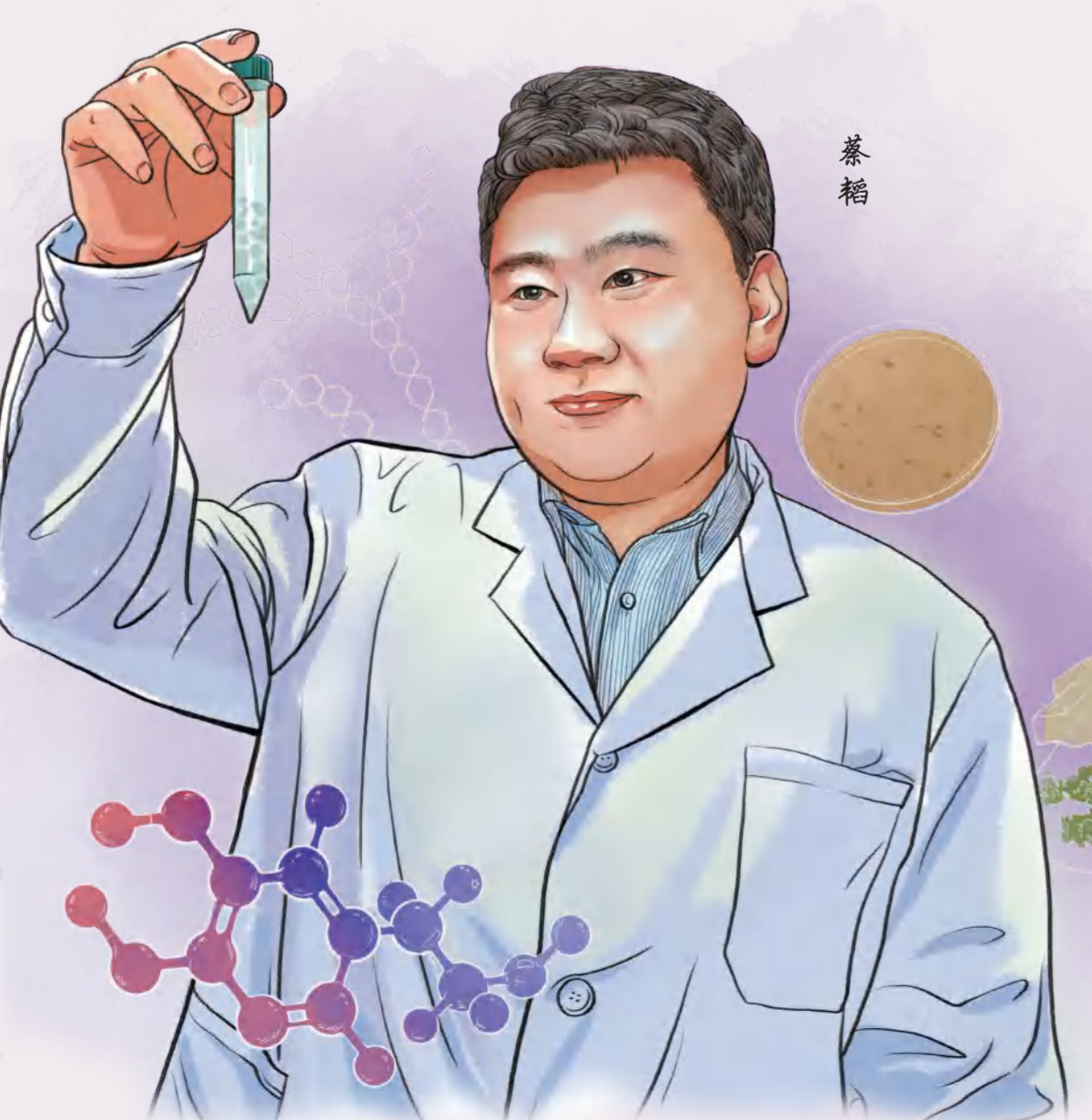
An associate researcher at the Tianjin Institute of Industrial Biotechnology of the Chinese Academy of Sciences, in 2021, a team consisting of Cai and the institute's director Ma Yanhe became the first in the world to artificially synthesize starch from carbon dioxide in a lab experiment.

The Journal's reviewers called Xue's discovery a "milestone" and "one of the most significant phenomena in topological physics". In April 2013, C. N. Yang, who won the Nobel Prize in physics in 1957, called Xue's work "the first of an academical of the Chinese Academy of Sciences and a fellow of the American Physical Society."

Xue received the first prize of the 2018 State Natural Science Award for his discovery of the quantum anomalous Hall effect in a lab experiment. He became the first Chinese citizen to win the Fritz London Memorial Prize in 2020. He is currently the president of the Southern University of Science and Technology in Shenzhen, Guangdong province.

Xue said a quality research university should encourage scientific exploration, tolerate failure, uphold academic freedom and enhance basic research.

It should also have an evaluation and support system that is beneficial for nurturing young talents, providing sustained support for basic research, and creating original innovations and breakthroughs, he added.



**Bao Xinhe, 63**

Passion, communication, unyielding curiosity and a keen eye for detail, along with decades of rigorous hard work, are some of the secrets that led to Bao Xinhe and his team discovering a new type of catalyst that holds promising industrial applications in fields of energy, oil refining, advanced materials and other sectors. The concept of "nano-confined catalysis" provides important guidance on the design of highly efficient catalysts, which are defined as substances that facilitate chemical reactions without undergoing any permanent chemical changes themselves.

"The key to making efficient chemical reactions with less environmental and energy impact lies in a deep understanding of reaction mechanisms," Bao said. "However, we don't always know how the reactants are converted into products, and what will come out in the end. It nations like a black box. The nano-confined catalysis concept can shed some light on this, leading to more precise and controllable chemical reactions."

One major application of the nano-confined catalysis concept is the creation of a new type of catalyst that can directly convert carbon monoxide and hydrogen derived from coal gasification into light olefins without using a lot of water and energy, Bao said. This creates a new path to the efficient industrial development of water and energy-saving coal chemicals.

Another application of the concept is a catalyst designed to clean traces of carbon monoxide from hydrogen at room temperature.

From a common technician to the chief engineer behind some of China's biggest technological innovations in transportation, Liang Jianying said she was fortunate to have worked in a time of rapid development in China's high-speed railway sector, which has provided ample opportunities for her team's ingenuity and efforts to shine.

"We hope that breakthroughs are made by a sudden stroke of genius, but in reality, making discoveries requires the long-term accumulation of knowledge and sharp intuition, so you can spot the tiniest anomalies and design the right experiments to rigorously probe the mechanism behind them," he added. For example, Bao's colleagues and students often contact him late at night to discuss the details of experiments and their results.

"With a strong emphasis on attention to detail, basic science and communication, Bao's lab has become a cradle of quality chemists, training more than 100 PhD students and more than 40 post-doctorate researchers.

"China is rich in coal but lacking in petroleum, so the effective and clean conversion of coal and natural gas into chemicals and other products is a matter of national importance," Bao said. "Basic research should target key scientific questions that affect socioeconomic issues."

## CHINA'S SCI-TECH COMMUNITY DEDICATED TO OPENNESS

The new round of scientific, technological and industrial innovation being promoted globally is having a profound influence on the world's development pattern. The international environment is becoming more complex with rising uncertainty and instability, which poses unprecedented challenges to mankind. Scientific and technological innovation serves as an important engine driving social development. All countries should uphold peace, development, cooperation and win-win partnership, and work together to cope with unknown risks and challenges.

China's sci-tech community has always adhered to the concept of openness, cooperation and innovative development. It focuses on joint research and technical exchanges and cooperation, and major State needs and the improvement of people's lives and health. The community is also committed to improving the innovative progress of science and technology, as well as stimulating the vitality of sci-tech innovation, promoting the spirit of scientists, and strengthening the ethical governance of science and technology.

It has proactively participated in global sci-tech governance and contributed to the building of a community with a shared future for humankind.

The China Association for Science and Technology, which is the largest non-governmental organization of sci-tech professionals in

China, serves as a bridge to link millions of Chinese scientists, engineers and other professionals working in this field.

One major task of the association is to conduct academic exchanges and promote the construction of world-class sci-tech journals and institutions, in a bid to give full play to its irreplaceable role in academic innovation.

The association insists on carrying forward the scientific spirit, popularizing scientific knowledge, organizing science education activities among the youth, and improving the scientific literacy of all citizens. The proportion of Chinese citizens with "scientific qualities" increased from 3.27 percent in 2010 to 10.56 percent in 2020.

Moreover, it highlights international sci-tech exchanges and cooperation. The association and its branches nationwide have joined 372 international sci-tech organizations, aiming to participate in global sci-tech governance and play a unique role in non-governmental international sci-tech exchanges and cooperation. Although profound changes have been taking place in both the domestic and international environment on the new stage of development, China will strengthen its confidence and actions to increase opening-up and cooperation.

Wen Gang, president of the China Association for Science and Technology



On May 30, China celebrates its sixth annual National Science and Technology Workers' Day. It is a day that commemorates China's latest scientific and technological achievements and the innovative, insightful and industrious workers that created them. Highlighting this year's theme of "striving for innovation excellence", "achieving self-reliance and strength" in sci-tech, we have profiled nine noted Chinese scientists and engineers. Each has pushed the global scientific frontiers, spurred economic growth, fulfilled the country's crucial needs or safeguarded public health. Together, they represent a diverse and inclusive group portrait of China's scientific and engineering community. Despite their different ages, genders and backgrounds, they are all pioneers of our time and the pride of a nation.

**Li Yu, 78**

One intriguing fact about China's historic victory over extreme poverty is that part of its foundations were built on edible fungi and decades of innovative research. Revitalizing rural China, promoting green development and pushing the envelope for better research and serve the nation's strategic needs are themes highlighted in the 14th Five-Year Plan (2021-25). Li Yu, a noted mycologist and an academical at the Chinese Academy of Engineering, managed to achieve all these goals using tiny mushrooms.

"This is because growing fungi is labor-, time- or resource-intensive. They are easy to plant and they require little investment," he said. "They grow very fast and they yield good financial returns. Thus, it is a first-choice industry for poverty alleviation."

China's agricultural industries produce a huge amount of plant stalks and animal manure every year, which can pollute the environment if not handled properly, Li added. "Now we can turn agricultural waste into fertile bags of nutrients for growing fungi," he said. "After they are harvested, we can process what's left in the bags into fertilizer, effectively turning trash into treasure."

"This will build a sustainable cycle in which farmers earn extra income from waste, consumers get tasty and healthy fungi products and the environment is cleaned in the process."

Since 2012, Li and his students have spent over 260 days most years traveling to 40 significantly impoverished regions across seven provinces to introduce fungi species and teach villagers how to use modern equipment and techniques to cultivate them.

His efforts have blossomed into a 35 billion yuan (\$5.38 billion) production and manufacturing industry that features unique products made from fungi including chips, supplements, tea and ice cream, all while lifting 350,000 families from poverty to middle class.

"Scientists, especially agricultural scientists, should not farm on the blackboard," Li said. "They need to get their feet in the field and use their research to help farmers become rich and live better lives."



A world-renowned mycologist who specializes in engineering and industrialization of fungi science and edible fungi. He is an academical at the Chinese Academy of Engineering and the president of the International Society of Medicinal Mushrooms.

His research has made substantial contribution to China's poverty alleviation effort, lifting hundreds of villages out of absolute poverty. In 2021, he received the honorary title of National Poverty Alleviation Modelist for his success in poverty eradication.

**Li Deren, 83**

"Love my China, strengthen my country" is the first tenet of the family teachings passed down by the great grandfather of renowned geomatics and geospatial information scientist Li Deren. Li said he is glad to have lived up to that motto. At the age of 83, he is still serving his country through his life-long passion of popularizing scientific knowledge, organizing science education activities among the youth, and improving the scientific literacy of all citizens.

Last year, Li and his team received the first prize of the 2020 State Scientific and Technological Progress Award for developing advanced Earth observation systems, which can swiftly provide high-definition images and information for applications including disaster relief, infrastructure construction and environmental protection.

The project took Li's team nearly 100 experts a total of 15 years to complete. Now, Li is hoping to improve that system further and create more digital products that can help countries around the world achieve sustainable development.

"Science should serve the country, and geomatics is a discipline critical to national security and economic development," he said. Collecting geographic data on nature and

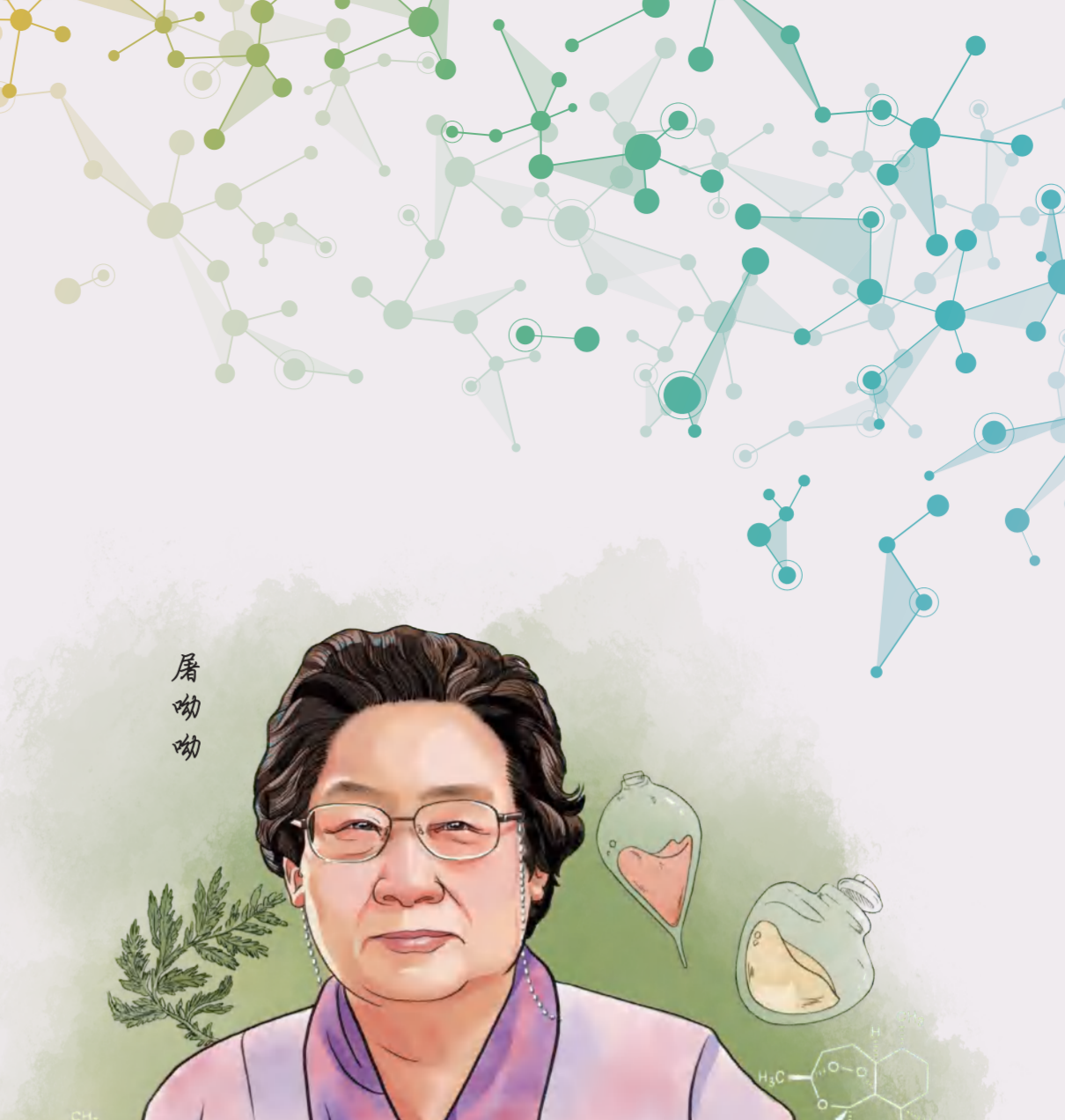
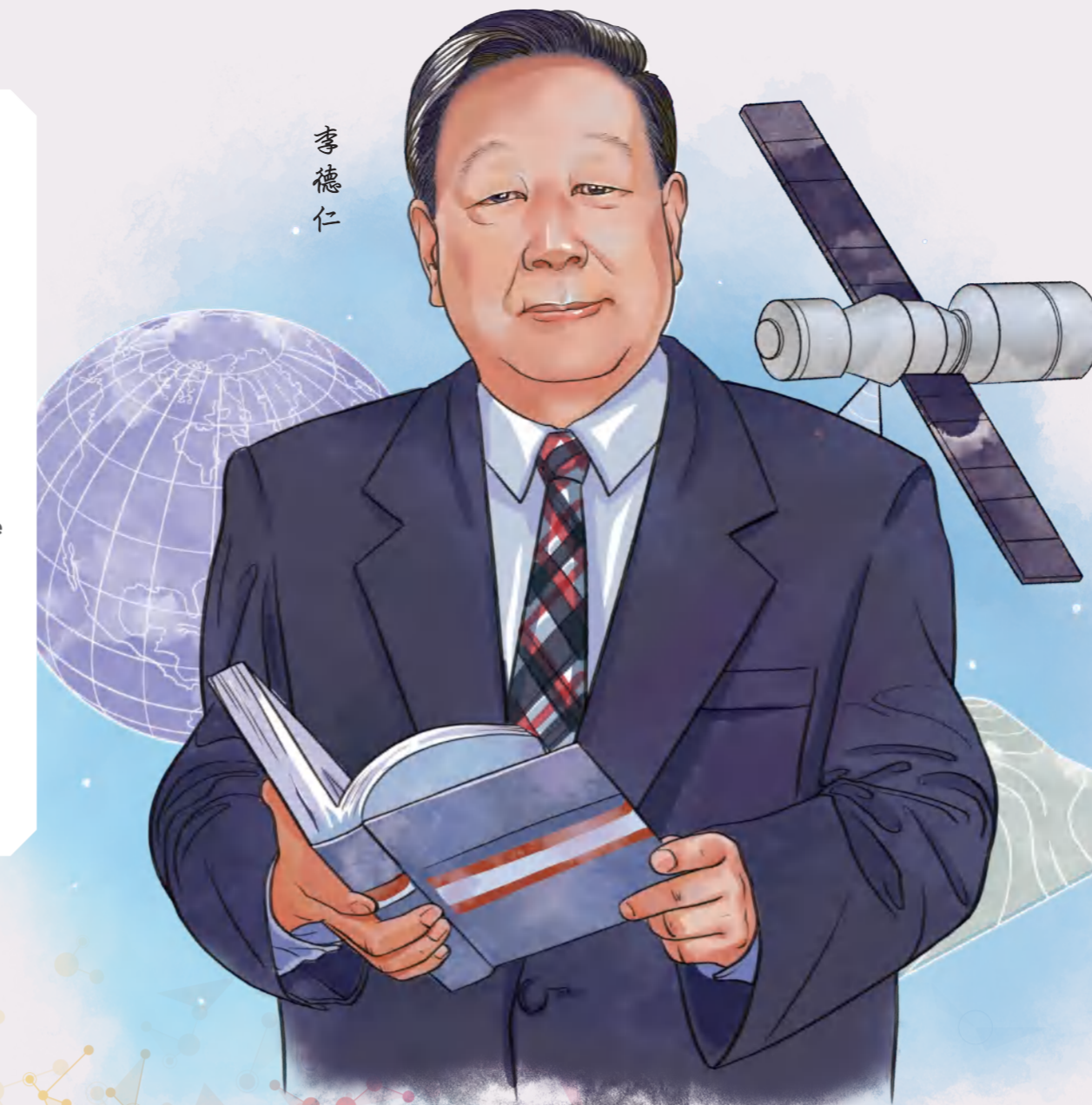
human activities helps experts and policymakers to arrive at informed decisions on sustainable development and other important needs, he added.

In March, Li and his team at the State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing at Wuhan University, Hubei province, published China's first global radar orthophoto. An orthophoto is an aerial or satellite image without geometrical distortions, allowing scientists to measure the true distances of features within the photograph.

This makes an orthophoto a key tool for agriculture, resource management, urban planning and other industries. Li said the map covers a land area of more than 300 million square kilometers, and the scientific data from the map are available for researchers around the world.

"We want to remove our reliance on foreign data, and pursue technological innovation to become more self-reliant," he said. "The most important element of the scientific spirit is to seek truth from facts. We should respect science and scientists, but we can't place blind faith in existing teachings or foreign technologies."

"We have to make original breakthroughs that can solve the critical needs of the country," he added.



**Wang Yingjun, 68**

For Wang Yingjun, the greatest joy is to see her work on biomedical materials can help so many patients and seniors live a better life. Over the last four decades, Wang has focused on creating and improving biomedical materials and high-end medical equipment. She invented the implant for regenerative restoration for load-bearing bone with large defects, which has led to products that have been used in over 400 hospitals in China and Europe, saving more than 300,000 patients from amputation and disability.

Now, Wang and her team are spearheading a demonstration center based on the Biomaterials Innovation and Cooperation Platform to develop and commercialize new biomedical materials and high-end medical equipment.

In the 1980s, there were not many Chinese researchers working on bioactive materials. At the time, the living and lab conditions were poor and Wang had no one to help her, but she loved her work so much that she would often stay up all night in the lab, or pour water on her dorm bed as cooling during the hot summer months.

"Once I entered this field, I couldn't help but to keep working hard, overcome obstacles and contribute wholeheartedly," she said. "Younger generations of scientists are becoming more capable, but the fighting spirit, dedication and principles from the older generations should be passed down and adopted."

Scientific research is doing what others have not done, so there won't be innovations without the innovative spirit," she said. "There is no shortcut or short-sighted pursuit of success when making innovations."

At the same time, a successful scientist should always be curious and hungry for new knowledge, which is important for inter-disciplinary research such as biomedical materials.

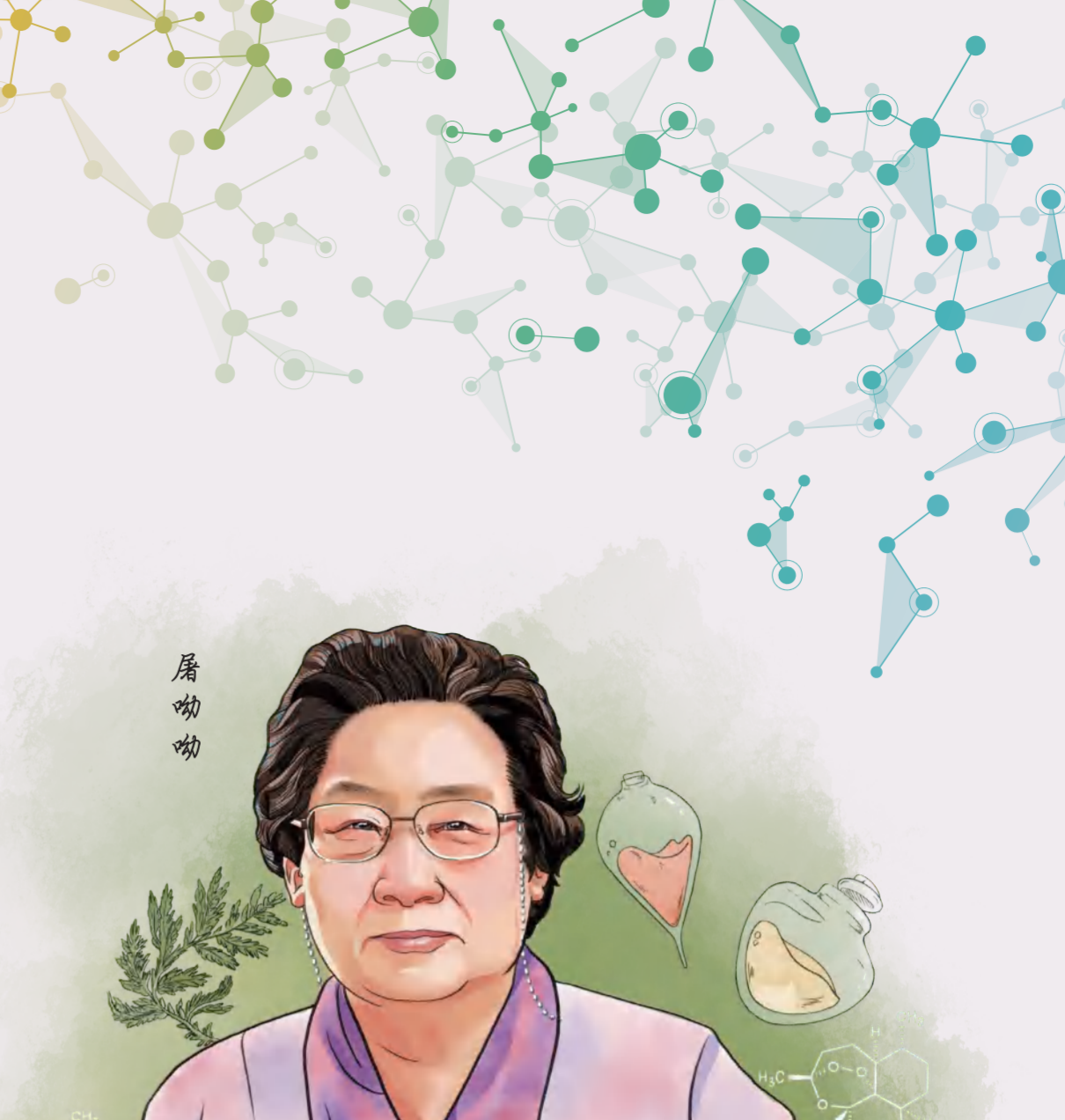
New technologies such as artificial intelligence, big data, 3D printing, as well as new advances in biology and life sciences, are contributing to the development of biomedical research, she said, adding the hardest part for a scientist is to keep innovating and venture into unfamiliar fields.

"Doing research in a lab is hard and industrializing scientific research is even harder, but I have no regrets," she said. "My dream is to let the Chinese people have access to world-class biomedical materials by Chinese scientists."

As a result, researchers in the United States, Canada, the United Kingdom, India and Japan are developing these types of vaccines. CanSino Biologics is one of the global front-runners in the race.

"We have always valued scientific and technological innovation as the No. 1 source of productivity," he said. He added that an innovative spirit, a strong will to overcome difficulties, and conducting research in a rigorous and thorough manner are key to success for scientists.

"We scientists should continue to nurture quality talents and make new innovations, and contribute our insight and effort to achieving self-reliance in science and technology," he said.



**Zhu Tao, 49**

Zhu Tao said recently that CanSino Biologics has been working hard to bring the future of COVID-19 vaccines, when they may replace the jab with a "huff", the procedure being as simple as "sipping coffee".

The recipient takes a deep breath from a cup containing the serum of the vaccine, holds the gas for around five seconds and slowly breathes out. The whole process takes around 10 seconds and is completely painless, making it ideal for individuals who are scared of needles, he said.

The vaccine has recently entered late-stage clinical trials. Preliminary data show that it is safe and can deliver broad protection against the COVID-19 virus and its mutated strains.

Inhaled or nasal spray COVID-19 vaccines are widely regarded as a game changer in the global fight against the highly transmissible Omicron variant, which primarily targets the upper airway. These types of vaccines will bolster the mucosal immunity of the respiratory tract, thus providing a first line of defense against the pathogen.

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"We scientists should continue to nurture quality talents and make new innovations, and contribute our insight and effort to achieving self-reliance in science and technology," he said.



A vaccine expert and the chief scientist at CanSino Biologics. He is a member of the Chinese People's Political Consultative Conference National Committee, China's highest political advisory body.

Zhu is one of the key scientists behind Convidemia, a single-dose adenovirus-based viral vector vaccine for COVID-19, which has been listed by the WHO for emergency use.