



A bounty of research monkeys in China is enabling neuroscience to flourish.

CHINA

# Science wins in five-year plan

*Oceanography, brain science and stem cells are among the Chinese research fields that look set to grow by 2020.*

BY DAVID CYRANOSKI

From a slowing economy to geopolitical tensions in the South China Sea, it is a testing time for China's ruling Communist Party. But according to its 13th Five-Year Plan, approved on 16 March, its science aspirations seem to be unbridled.

China already intended its research expenditure to rise to 2.5% of gross domestic product by 2020, from less than 2.2% over the past 5 years.

A draft version of the latest Five Year Plan, as well as statements by key politicians, bolsters the idea that innovation through science and technology is a priority. For some of the themes that are set to shape Chinese research over the next five years, *Nature* spoke to a range of scientists.

## THE OCEAN DEEP

In 2012, 'oceanauts' aboard the research submersible *Jiaolong* descended more than 7,000 metres beneath the waves, marking

China's entry into an elite club of nations capable of reaching the hadal zone — the deepest part of the ocean, which begins at 6,000 metres below sea level. Over the next five years, Chinese scientists will build one crewed and one uncrewed submersible, according to a plan released by the science ministry in February, each of which will be able to reach depths of 11,000 metres — the very bottom of the hadal zone.

"For deep-sea technology, this five years will be a golden period," says Cui Weicheng of the Hadal Science and Technology Research Center at Shanghai Ocean University.

The uncrewed vessel will be similar to *Nereus*, the advanced US submersible that imploded in 2014 and will not be replaced. The crewed vessel will hold at least two people, more than the *DEEPSEA CHALLENGER*, which took

**"For deep-sea technology, this five years will be a golden period."**

film director James Cameron on a solo dive to the deepest point of the Mariana Trench in 2012. The hadal zone is one of the most poorly studied habitats on Earth, and is home to mysterious tube worms, sea cucumbers and jellyfish. Researchers are also interested in its role in the carbon cycle, because the microbes there digest a surprising amount of organic matter. Chinese scientists hope to use both submersibles to explore the zone in more detail than before.

Independently of the latest five-year plan, Cui has also developed a 'movable laboratory' composed of three landers, a robotic submersible and a crewed vehicle (W. Cui *et al. Meth. Oceanogr.* **10**, 178–193; 2014). The robotic submersible and first lander were tested down to 4,000 metres last October. A mother ship that controls the robot and landers is due to be launched on 24 March, and the first scientific expedition is planned for August, in the New Britain Trench off Papua New Guinea. Together, these projects "could help shorten the gap" between Chinese ocean science and technology and the most advanced capabilities elsewhere, says Cui.

## BRAIN SCIENCE

The United States, Europe and Japan have each announced their own massive projects to map the brain, and China has had one in the works for several years. The latest five-year plan calls for brain science to be a priority — and most of the resources are expected to be channelled through the China project, which is due to be officially announced shortly, say Chinese researchers.

The brain project is expected to focus on brain disease, in particular through studying animal models, and on artificial intelligence. Scientists in China acknowledge that they are far behind the rest of the world in terms of top-level talent in brain science, but several factors could enable them to catch up. China's neuroscience community is growing — the Chinese Neuroscience Society now has 6,000 members, compared to just 1,500 ten years ago — and the country has hundreds of thousands of research monkeys. Furthermore, China's tens of millions of patients with psychiatric or degenerative brain disease will facilitate clinical studies.

The research monkeys have already allowed Chinese researchers to take the lead in using gene-editing technologies to produce models of autism spectrum disorder and other conditions. The bounty of research animals is also starting to draw interest from abroad — a primate research centre in Shenzhen is being jointly established with the Cambridge-based Massachusetts Institute of Technology.

## CONSERVATION CORRIDORS

With actor Jackie Chan and basketball star Yao Ming involved in campaigns attacking the trade in protected animals such as bears, which are milked for their bile, and elephants, targeted for their ivory, conservation has

YAN-HONG NIE

become a high-profile issue in China.

The latest five-year plan will launch efforts to protect the giant panda, tiger and Asian elephant in the wild, says Zhang Li, a conservation biologist at Beijing Normal University. “There will be a big budget to restore habitat for these species,” says Zhang. The projects will focus on corridors between protected areas that greatly increase habitats by letting the animals move from one reserve to another.

A biodiversity hotspot between Laos, Myanmar and the southwestern Chinese province of Yunnan requires protection in particular, says Stuart Pimm, a biodiversity specialist at Duke University in Durham, North Carolina. The forest there has been converted into rubber plantations, he says, “and the level of hunting is worse than any place I’ve ever been”. But a focus on protecting pandas, elephants and tigers could leave other animals at risk, he pointed out in November (B. V. Li and S. L. Pimm *Conserv. Biol.* 30, 329–339; 2016).

### STEM CELLS

In the wake of the five-year plan, China will gain a funding initiative called ‘Stem Cell and Translational Research’, according to stem-cell researchers Pei Gang, president of Tongji University in Shanghai, and Pei Duanqing, director of the Guangzhou Institutes of Biomedicine and Health. The stem-cell programme will be one of the first to award grants under a new competitive review and evaluation process, replacing a system that critics said rewarded scientific and political connections rather than merit. Following the previous five year plan, China invested roughly 3 billion yuan (about



Smog hits Beijing, a pollution black spot, on 25 December 2015 — for the fourth time that month.

US\$460 million) in stem-cell research.

The pair says that there will be a big increase over the next five years but did not give exact figures. “Given the size of its population and the wide spectrum of unmet medical needs, China recognizes the promise of stem-cell and regenerative medicine as one of the key thrusts for modernizing its medical-service system,” says Pei Gang.

### POLLUTION CONTROL

In a country that places great value on social harmony, air and water pollution are the trigger for an increasing number of protests.

Under a plan that began in 2012, the government is already trying to reduce the levels of airborne particulate matter measuring less than 2.5 micrometres across (PM<sub>2.5</sub>), which is small enough to penetrate deep into the respiratory system. By 2017, it wants to achieve reductions of 25% in the Beijing area, 20% in

the Yangtze River Delta and greater Shanghai area, and 15% in the Pearl River Delta. Major nationwide environmental initiatives outlined in the latest five-year plan will tackle transportation, clean energy and environmental protection, says Wei-xian Zhang, director of the State Key Lab for Pollution Control at Tongji University.

The government will also target pollution black spots, such as smog in Beijing and fertilizer pollution in Lake Tai near Shanghai. Funding to control air pollution alone will increase by at least four times, says Zhang, and several new national laboratories focusing on clean energy and environmental research have also been funded for the next five years. “China is and will continue to be the largest market in air-, soil- and water-pollution control technologies,” says Zhang. “To some degree, the whole country will be a huge laboratory for environmental research, such as smog mitigation.” ■

## CLIMATE

# China’s carbon emissions could peak sooner than forecast

*Five-year plan advances policy to reduce reliance on coal and expand renewable energy.*

BY JEFF TOLLEFSON

The world’s largest greenhouse-gas emitter is turning a corner on climate change. China’s 13th Five-Year Plan reinforces the country’s seismic shift away from dirty coal, and many specialists now think that Chinese emissions are already nearing their peak — well ahead of schedule.

Approved on 16 March, the plan sets out basic goals and requirements for energy use and the environment until 2020 — and establishes an overarching strategy for economic development, as well as some themes to shape the

direction of research (see opposite). In particular, the document strengthens mandatory targets put in place over the past decade to reduce energy use, curb air pollution and promote the development of wind, solar and nuclear power.

These efforts have begun to work: China’s coal consumption declined by an estimated 3.7% in 2015, according to statistics released in February by the Chinese government.

Such a decrease is unprecedented, says Barbara Finamore, Asia director for the Natural Resources Defense Council, an environmental-advocacy group headquartered in New York City. “I think it’s catching everyone by surprise.”

The new plan calls for an 18% reduction in carbon intensity, which is a measure of how much carbon dioxide is emitted per unit of gross domestic product. That is slightly stronger than the 17% target set in 2011. The latest plan also seeks to limit the country’s total energy use. China consumed energy equivalent to 4.3 billion tonnes of coal in 2015, and the plan would seek to cap that figure at the equivalent of 5 billion tonnes by 2020.

Nonetheless, the document does not specify how China will hit its targets. “The point of this is to set the tone and direction,” says Ranping Song, who handles climate ▶