ARTICLES: 303

CORRECTED COUNT: 150.03

China

Economic growth in recent years has been matched by a huge increase in scientific output. This trend continued through 2012 in contrast with many other countries hit by the global financial malaise. While Chinese research improves its international standing and recognition, at home there are concerns that cultural factors are impeding innovation.

Jun Wang, the head of genome-sequencing powerhouse BGI, was one of *Nature*'s "Ten people who mattered" in 2012. Recognition of him as a "genome juggernaut" acknowledges one of many players making the most of China's increased investment in science and technology. The resultant surge in scientific output is laid bare in the country's continual rise up the NPI. Since 2008, China's output as measured in corrected count (CC) has increased four-fold compared to Japan's increase of only 50% (see 'A year of growth', page 6).

The Chinese government plans to increase R&D expenditure from its 2010 level of 1.75% of gross domestic product (GDP) to at least 2.5% by 2020 — a small proportion if considered globally. But the scale of the Chinese GDP means that the country's total R&D spending is second only to the United States.

While the quantity of Chinese science is growing, commentators say its quality needs to be improved. The impact of published research, as measured by the number of citations per article, is lower than those produced by Japan, the United States and other leading science nations. Bai Chunli, president of the Chinese Academy of Sciences (CAS), despite his institution narrowly missing the top spot in the Asia-Pacific, says scientific research in his country is "still weak".

Even so, China has steadily expanded its NPI presence. In 2011, China's CC amounted to 3.3% of the global publication count; in 2012 that grew to 4.2%. Almost all Chinese institutes have risen through the ranks and the country now has four in the Global Top 100, including Tsinghua University.

China's research behemoth CAS, which has 60,000 employees working in more than 100 institutes, dominates national output. It leads all other Asia-Pacific institutions for publications in *Nature* as well as *Nature Structural & Molecular Biology*, *Nature Cell Biology* and *Nature Methods*. CAS published 50% more papers in Nature journals in 2012 than it did in 2011, pushing it from 23rd to 12th in the global rankings.

In the Asia-Pacific region, CAS missed out on the top spot by less than

CHINA TOP TEN

China has 51 institutions in the Asia-Pacific top 200

ASIA-PACIFIC RANK 2012	INSTITUTION	2012 NATIONAL RANK	2012 CORRECTED COUNT	2012 ARTICLES	2011 NATIONAL RANK	2011 CORRECTED COUNT	2011 ARTICLES	2008–12 NATIONAL RANK	2008–12 CORRECTED COUNT	2008–12 ARTICLES
2	Chinese Academy of Sciences	1	37.88	91	1	22.52	62	1	103.92	265
8	University of Science & Technology of China	2	9.46	17	2	8.58	17	2	26.53	56
11	Tsinghua University	3	8.26	31	4	6.36	16	3	25.39	77
12	Peking University	4	8.10	29	3	7.24	21	4	23.17	83
17	Shanghai Jiao Tong University	5	6.62	30	7	3.74	21	6	13.33	68
18	BGI	6	6.27	20	10	2.97	11	5	14.04	42
22	Zhejiang University	7	4.70	15	11	2.96	8	11	9.98	40
25	Huazhong University of Science & Technology	8	4.41	14	20	1.00	6	15	5.76	22
29	Fudan University	9	3.90	13	13	2.34	14	21	9.19	47
41	The University of Hong Kong	10	2.92	14	8	3.58	12	9	10.26	42

CHINA 2012

POPULATION:	1.353 Bn
RESEARCHERS:	1.152 M

SOURCE: UNESCO

two points. First position was retained by the University of Tokyo. But in January 2013, CAS overtook the University of Tokyo in the 12-month rolling count for the Asia-Pacific (nature.asia/publishing-index-asia-pacific). This was the first change at the top of the rankings in the region since the NPI began. As we go to press CAS retains its spot at the top but given that these two heavyweight institutions remain relatively close their positions may conceivably fluctuate for a while yet. CAS is not the only Chinese institution experiencing such ascendancy. Among the country's top ten universities, all except one — the University of Hong Kong — ranked higher in 2012 than in 2011. The improvement in Chinese science is reflected at all levels, with the number of institutions publishing in Nature journals growing by 42% — from 153 in 2011 to 218 in 2012. In 2008 the number was less than 50.

LIFE SCIENCES STRENGTH

At the end of 2011 US pharmaceutical giant Merck announced it would spend US$1.5 billion over the next five years on R&D in Beijing. Merck's confidence is echoed by a growing number of companies setting up large R&D centres in China. Domestic companies are also joining forces with foreign organizations, including Merck and Pfizer, for drug and clinical development projects. Encouraged by government spending on healthcare, particularly policies allocating huge sums to drug development, China's life sciences institutions are growing globally.

Life sciences research contributed two-thirds of China's 2012 CC and CAS is top of the competitive life sciences institutional table, ahead of the University of Tokyo on CC. BGI has been particularly prolific, producing studies on the genomes of agriculturally important species such as cotton, maize and tomato, and studies of mutations associated with diseases such as renal cell carcinoma and liver cancer. It ranked higher than any other Asia-Pacific institution in both *Nature Genetics* and *Nature Biotechnology* in 2012 and was in fourth and first place, respectively over the past five years (see 'Top institutions by journal', page 46).

The country was also well represented in the physical sciences. CAS, along with the Chinese Academy of Engineering, published a list of the top 10 science events of 2012. It included a February 2012 *Nature* paper by Jian-Wei Pan, from the University of Science and Technology of China (ranked second in the country) which described a breakthrough in quantum information processing.

HONG KONG FALTERS

Buoyed by strong life sciences, Shanghai Jiao Tong University, BGI, Zhejiang University and the Huazhong University of Science and Technology (HUST) moved up the national ranking to take the 5th to 8th places respectively. HUST's rise from 25th in 2011 is impressive. A highlight was a study showing gene expression and physiological conditions in the nematode *Caenorhabditis elegans* can be regulated by another species: its food source, *Escherichia coli*. Fudan University rose to 9th place with strong contributions in life and physical sciences.

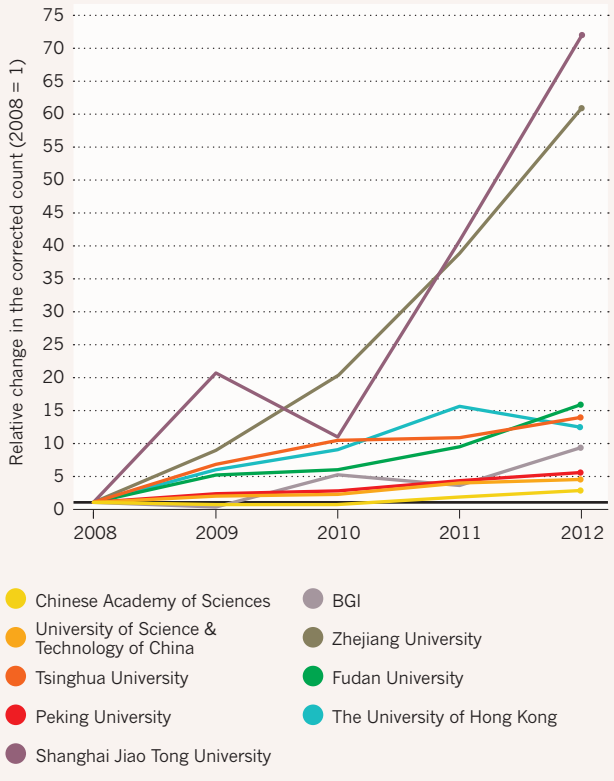
Two Hong Kong institutions fell in the ranking: the University of Hong Kong moved from 8th to 10th despite increasing its CC by one point, and Hong Kong University of Science and Technology fell from 5th to 11th spot. Hong Kong's leaders are not giving science the same priority as it receives in mainland China, allocating just 0.7% of GDP to R&D.

Despite a strong showing in the 2012 NPI, Chinese science has much room for improvement. "China still has an environment and atmosphere that is not conducive to big innovations, including a lack of investment in human resources, excessive competition, fighting over resources, sectoral interests, impatience and a longing for quick success," Bai Chunli said at the Communist Party's 18th national congress. Less than 5% of its R&D money is spent on basic research, much less than the United States' spend of 19%.

If its longing for success, 'quick' or otherwise, is to be realized, China will need to address these issues. ■

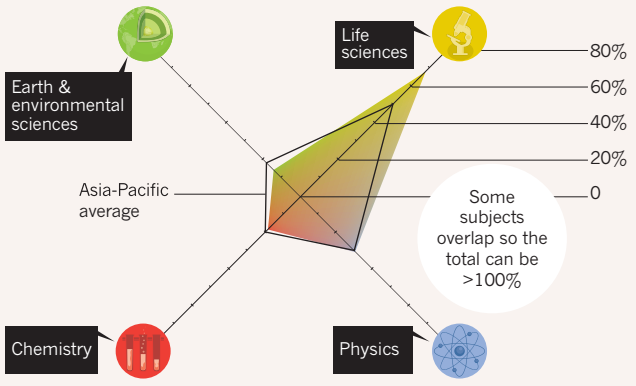
INSTITUTIONAL PUBLISHING TRENDS

Charting the changes in output from the top nine institutions since 2008.



RESEARCH STRENGTHS

The subject areas in which China achieved its corrected count.



The countries with which China collaborated most. Its domestic corrected count is shown for comparison.