

# CAS in the Lens of Nature Index: A Leading Contributor to High Quality Science

By SONG Jianlan (Staff Reporter)

CAS has emerged as a world-leading institutional contributor to high-level research outputs, as shown by the Nature Index, a new indicator for high quality science developed and monthly updated by the Nature Publishing Group (NPG), based on publication data from a total of 68 influential natural science journals within or beyond its own umbrella. CAS remained at the top of the global institution output list of the Index released over the past four months, if sorted by weighted fractional counts (WFC), a new metric developed by the NPG to measure institutional contributions. The news has aroused mixed and interesting responses among CAS researchers.

CAS was “making the leap from a regional to a global leader”, summarized NPG in its Supplement *Nature Index 2014 China* published in Dec 2014. As an aircraft carrier integrating over 100 institutes, CAS ranked only second by article counts (AC) to the French National Centre for Scientific Research (CNRS) in the most recently updated institution output list of the Index (natureindex.com; Feb 2015), with at least one CAS-affiliated author contributing to 3,114 papers. When sorted by WFC, however, it rose to the top of the list, scoring 1303.69 points. CAS was the No.1 contributor, ahead of Harvard University, with a WFC of 1209.46 points, when NPG first launched this Index with the *Nature Index 2014 Global*

supplement published in Nov 2014, based on data from Jan to Dec 2013. At that time based on its AC, CAS was the third (behind both CNRS and Max Planck Society) largest contributor with at least one author on 2,661 papers in the indexed journals.

CAS was the a leading contributor in chemistry, physics, earth and environmental sciences, according to NPG.

The 68 journals in the Nature Index were independently chosen by a panel of prestigious scientists led by Prof. John Morton from University College London, UK and Dr. Yin-Biao Sun from King's College of London, UK. The Nature Index provides three measures to track affiliation data. The simplest is the AC. The Index also includes the “fractional count (FC)” which divides an article according to the number of authors contributing to it. For instance, if the total FC available per paper is 1, a paper with 10 authors means each author receives an FC of 0.1. The third measure is the WFC, which applies a one-fifth weighting to the FC from papers in four journals in astronomy and astrophysics to proportionally balance the overrepresentation of this field's output as a whole in the Index by these large journals.

Particularly, NPG highlighted the contributions of CAS to global high quality research in its supplement the *Nature Index 2014 China*, by giving a detailed analysis of the outputs of CAS institutes in different disciplines. According to this analysis, the Institute of Chemistry (ICCS), the Institute of Physics (IOP), the Shanghai Institutes for Biological Sciences (SIBS), the Institute of Atmospheric Physics (IAP) and the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) are dominant institutes in the fields of chemistry, physics, life sciences, earth and environmental science, and paleontology, respectively.

## Cautious Optimism

CAS scientists respond to the news with mixed attitudes and opinions. Many interpret it as an encouraging sign, particularly when criticism and scepticism over this country

Region/country: Global Subject/journals: All Sort by: Weighted fracti Generate

Note: There are many institutions with foreign research facilities located outside of the their home country. Region/country outputs contain articles affiliated with facilities located in the selected region/country.

Institution	AC	FC	WFC
1. Chinese Academy of Sciences (CAS)	3114	1443.01	1303.69
2. Harvard University	2612	939.88	864.01
3. French National Centre for Scientific Research (CNRS)	4894	896.86	760.60
4. Max Planck Society	2944	869.72	648.13
5. Stanford University	1263	568.32	538.54
6. Massachusetts Institute of Technology (MIT)	1475	526.55	501.99

CAS tops the institution output list by WFC, according to the latest Nature Index update in Feb 2015. (Source: NatureIndex.com)

linger that quality of its research outputs has been overshadowed by the steep rise in quantity and, its high position in the ranking of research spenders.

“We shall be confident of our own performance,” remarked Prof. ZHOU Zhaocai, Principal Investigator at the Shanghai Institute of Biochemistry and Cell Biology (SIBCB) under SIBS: “with no doubt we are doing better than before.”

ZHOU just published a paper in the *Nature Immunology* in early Feb 2015. His employer, SIBS earned a WFC of 49.3 in 2013, and in the two prestigious journals *Nature* and *Science* alone, it published eight articles, scoring the highest WFC in this split among CAS institutes.

Meanwhile, the optimism held by scientists is offset by an anxiety to improve efficiency and a pervasive vigilance against so-called “SCI mania”, the over emphasis on publications in performance evaluation and assessment.

“Don’t forget we have a large staff doing research,” ZHOU could not help pointing out the contribution of the big volume to the obviously high ranking: “It is unfair to compare the output of such a big group of institutes with that of a single institution, and it’s dangerous to over-state the importance of the ranking,” he asserted.

ZHOU’s remarks, representing the opinions of quite a lot of researchers, could be footnoted by the country-specific researcher efficiency given by the Nature Index.

The Index measures the researcher efficiency of a country or an institution with the unit WFC per thousand researchers. According to the data released in Nov 2014, China went marginally after Japan and South Korea, and lagged far behind Singapore in this aspect.

The overall researcher efficiency (in WFC per 1,000 researchers) of CAS could be calculated by dividing its total WFC with its total number of researchers, namely about 48,500. The result turns out to be about 26.88, almost four



On Nov 21, 2014, CAS President, Prof. BAI Chunli meets with Dr. Annette Thomas, CEO of Macmillan Science and Education, the parent company of NPG in Beijing, and receives from her a crystal plaque as a token of congratulations to CAS for its contribution to high-quality research. (Photo by LI Hui, CAS)

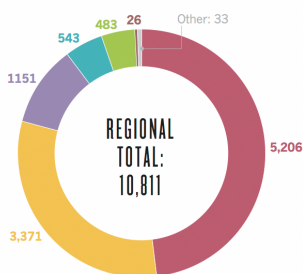
times as the average of China (less than 4) and twice that of Singapore (over 14), yet far lower than some internationally prestigious institute alliances like CNRS, which scored almost 68 if calculated from data of the same term.

This simple calculation of researcher efficiency might not correctly mirror the efficiency of CAS, however, given that not all of its affiliated organs are engaged in research. For some of them, publication might not be the primary goal or the main output. Therefore more reasonable metric is needed to evaluate the overall efficiency of CAS. In the fields of fundamental research, researcher efficiency varies across its institutes, but some were encouragingly named by NPG as highly efficient. ICCAS, which was described as the most efficient, contributed a WFC of 125 with only 123 researchers, presenting “one of the highest ratios we have calculated for any institution” as indicated by NPG.

## EAST & SOUTHEAST ASIA ANALYSIS

### Countries' weighted fractional count (WFC)

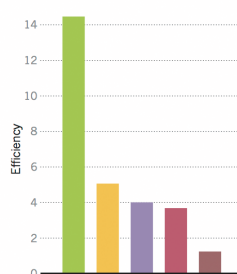
Of the 15 countries in the region, three dominate the scientific output, led by China.



1. Source: UNESCO. 2. Subjects overlap, so the total for each country can be >100%.

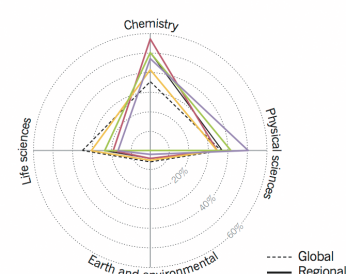
### Researcher efficiency

WFC per 1,000 researchers<sup>1</sup>.



### Research strengths

Most countries focus on chemistry and physical sciences. Japan is strongest in the life sciences<sup>2</sup>.



An analysis of country outputs in East and Southeast Asia indicates the researcher efficiency of China lags behind Singapore, Japan and South Korea. (Image extracted from *Nature Index 2014 Global*, S73, published in Nov 2014)



## Pervasive Vigilance

Nowadays it has become a common view among CAS researchers that “publication list is not everything”, representing a pervasive vigilance against the so-called “SCI mania” and an urge to focus on science itself.

Prof. ZHOU Zhaocai interpreted the mania from a novel perspective: “The SCI mania or fever maybe just reflect that we are still not good enough, otherwise publishing a paper in a top journal like *Nature* would be too commonplace to be worth mentioning,” he said.

ZHOU also expressed his worries about the eager for quick success and instant returns from investment in science: “Some explorations in fundamental research might take decades or even longer to see returns. It is not reasonable to set a strict timetable and wait to reap papers at the end of a short term,” he said. “Whatever, just do your best with the resources available in hand, however limited, and carry on. This is what a scientist can do,” he concluded.

Prof. ZENG Yi, ZHOU’s SIBCB colleague and author of a *Nature* paper published online in Oct 2014, did not even notice the high ranking of CAS. “No, I didn’t notice the news,” she said: “I only noted the earlier report saying the ranking was the fourth.” When invited to comment on the seemingly strengthened research capacity, she reminded the author of the gap between the top domestic institutes and those of the US in the field of biology, instead.

Just as ZENG, many other CAS researchers stay calm and reluctant to comment, suggesting a tacit agreement. Some even frankly expressed online their worries about unwarranted pride of the high ranking. “It is meaningless to fixate on such figures like rankings,” commented some bloggers on the ScienceNet.com: “Better look at the problems and work.”

“The Nature Index provides a new way to look at the scientific literature – and to those research organizations that contribute to it,” also said Nick Campbell, Executive Editor, *Nature*. “We want users to be able to tease out patterns of research, look at trends, analyse individual strengths and investigate how institutions and countries collaborate.”

## Increased Visibility

Prof. ZHOU Zhonghe, head of IVPP, also attributed the apparently high ranking of CAS to its huge volume when asked of his opinions, meanwhile urged caution against over-interpretation of the Index, saying it is very difficult to compare the outputs of different institutions across disciplines.

ZHOU welcomed the Index as a new indicator for high-level research outputs, however. “I would say WFC is a better measure than Impact Factor,” he remarked.

NATURE INDEX CHINA

## Chinese Academy of Sciences

For 65 years, the Chinese Academy of Sciences has been a rich source of technological innovation, scientific discovery and aspiring minds. Making the leap from a regional to a global leader, researchers are taking the intellectual powerhouse to soaring new heights.

ARTICLE COUNT (AC): 2,661  
FRACTIONAL COUNT (FC): 1,351  
WEIGHTED FRACTIONAL COUNT (WFC): 1,209

The Chinese Academy of Sciences (CAS) is the world’s largest scientific organization, with about 48,500 researchers in 114 directly controlled institutes spread across the country. Its annual budget for 2013 was US\$8.4 billion. Over the last 65 years, CAS has made many important discoveries and technological advances across diverse fields, including making the first synthetic insulin from bovine sources (1965); building China’s first particle accelerator, the Beijing Electron-Positron Collider (1984); and the discovery of iron-based high-temperature superconductors (2008). There are 49 CAS institutes based in Beijing, including the Institute of Chemistry (ICAS), the Institute of Physics (IOP), the Institute of Atmospheric Physics (IAP) and the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP). Key institutes outside Beijing include the Changchun Institute of Applied Chemistry (CIAC), Dalian Institute of Chemical Physics (DICP), Shanghai Institute of

worldwide — and in fact has a higher WFC than many scientifically advanced countries — including Spain, Switzerland and South Korea. CAS is also a regular contributor to *Nature* and *Science*, having published 54 articles (WFC = 18.6) in these two top journals in 2013 (see ‘*Nature and Science breakdown*’). By WFC this represents one-third of China’s total contribution to *Nature* and *Science*, reflecting the organization’s strength in basic research.

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materials chemistry, organic chemistry and physical chemistry. Top contributor is Lanqun Xiao from the laboratory of analytical chemistry for life sciences, who co-authored seven articles (WFC = 4.9) on electrochemical biosensors. He is closely followed by Huimin Ma, from the same laboratory, who wrote four articles with ICCAS colleagues (WFC = 4) on fluorescent probes.

Another major contributor at ICCAS is Song Ye from the molecular recognition and selective synthesis laboratory. In 2013, Ye led four articles (WFC = 3.9) on the development of novel catalysts for use in asymmetric synthesis, all in the journal *Angewandte Chemie International Edition*. Ye explains that in normal asymmetric synthesis of pharmaceuticals using metal catalysts, the catalyst must be removed from solution in a post-treatment process to prevent toxic metals from getting into the final product. “We have discovered an organocatalyst that eliminates the need for this step,” he says.

Yuguo Guo from the Key Laboratory of

NPG’s spotlight on CAS in its Supplement *Nature Index 2014 China* in Dec 2014 with an in-depth analysis of the research performance of CAS institutes. (Image extracted from *Nature Index 2014 China*, S56)

ZHOU’s institute, evaluated as dominant in the field of paleontology, ranked the highest among CAS institutes by the ratio of publications in *Science* and *Nature* in its portfolio, according to the special analysis by NPG given in the *Nature Index 2014 China* mentioned above.

Notably, papers on dinosaurs and birds contributed by IVPP scientists were highlighted in this analysis. Moreover, their contributions were also recognized by another prestigious annual top 10 list. The breakthrough in understanding the transition from dinosaurs to birds, to which ZHOU and his IVPP colleagues and collaborators made prominent contributions, was listed in the top 10 ground-breaking discoveries and achievements by the journal *Science* in Dec 2014.

This marked the second time an achievement accomplished by CAS scientists made the *Science* top 10 list in the latter’s 20-year history. In 2012 a group of researchers from the Institute of High Energy Physics reported from the Daya Bay Nuclear Power Plant their measurement of the third, also the last, mixing angle of neutrino oscillation,  $\theta_{13}$ , which was believed to be important in explaining why the universe contains so much matter and so little antimatter.

On top of this, another work presented by IVPP as the first contributor, an analysis of genome sequence of a 45,000-year-old modern human from western Siberia hinting early migration of modern humans across Asia, was listed in the *Nature* version of 2014 top 10 scientific events.

At the beginning of the Year of the Goat, CAS’s launching of the “Pioneering Initiative” is gaining momentum. To implement the Initiative, institutes affiliated to CAS will be divided into four categories, each administered differently according to its distinct characteristics. Under this framework, research outputs, not limited to publications, might be assessed more reasonably, to better encourage innovations of different nature. More is coming.