

China Surpassed US in High-Quality Natural-Science Research in 2022

Leading international science journal, Nature, Rates China Number One

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"For the first time, China has overtaken the United States as the number one ranked country or territory for contributions to research articles published in the Nature Index of high-quality natural-science journals," [reported](#) the journal Nature on findings for the year 2022.

Needless to say, such an assessment has profound implications in the face of American efforts to stifle Chinese scientific and technical development and to "decouple" Chinese from American science. The contest over microchips is now in the limelight, but that is only a single skirmish in a larger competition. In the long term the achievements of Chinese science and the foundations on which it is built will determine how China fares.

The Nature Index

The journal Nature, founded in 1869 and based in London is regarded by many as the world's leading multidisciplinary journal of scientific research and is one of the [most read, most cited and most respected](#). Nature and Science, the journal of the AAAS (American Association of the Advancement of Science), are arguably the world's two most prestigious multidisciplinary science journals. In a recent [supplement](#) to its weekly issues, Nature reported in detail on China's top ranking for 2022.

The journal's annual rating of a country's standing in the natural sciences is based on all publications appearing in 82 of the most outstanding peer-reviewed scientific journals in the fields of biological sciences, chemistry, physical sciences, and earth and environmental sciences. The very selective choice of the highest quality journals made by a panel of leading scientists is designed to give a measure of the amount of *high-quality* research. The assessment is not simply a measure of quantity. China [overtook the US by that simple metric, the total number](#) of science publications in 2017, according to the US National

Science Foundation.

Using all the articles that appear in these 82 journals each calendar year, Nature computes its signature metric called the “Share.” The contribution of a country or an institution to all of these articles is the “[Share](#).” The open database containing all the information used in this process is called the [Nature Index](#).

Typically, at least two peer reviewers and an editor decide the fate of each of tens of thousands of articles in the Nature Index each year. In this way, a veritable international army of the best scientists are making judgements that contribute to the Share metric. Consciously, they are judging the quality of each submission they examine for publication, but the sum of their judgements underlies the Share metric. It is a metric based not on citations but on *acceptances* resulting from highly demanding peer reviews. It amounts to an international self-evaluation by the scientists themselves to determine the overall quality and quantity of each nation and institution.

China’s Meteoric Rise in the Natural Sciences

What are the Shares for each nation in [the natural sciences for calendar year 2022](#)?

- China: 19,373
- United States: 17,610

This finding is reinforced by another measure of high-quality science, the contribution to papers in the top 1% of most cited publications. Here too [China surpassed the US in 2022](#) according to Japan’s National Institute of Science and Technology.

China’s has risen with breathtaking rapidity. The earliest Share ratings are for 2016, and there the standings of the US and China were reversed to a remarkable degree, with China’s Share only 37% that of the US.

For 2016 the Share was:

- United States: 20,767
- China: 7,676

But there is more to the story. From [2021 to 2022](#), China’s Share adjusted for overall global total grew by 21% whereas the US’s fell by 7%! This pattern of a US decline and a Chinese rise has held each year since it was [first tracked in 2016](#).

At this point it is worth noting that the 82 journals in the Nature Index are published in the West! Given that fact, it is unlikely, to say the least, that a pro-China bias is at work in the calculations of Share.

Finally, China’s science is often stereotyped as imitative and unoriginal. However, the journals listed in the Nature Index strive to publish original, ground breaking research. China’s high standing in the Shares rating is not consistent with the stereotype. This conclusion is bolstered by a [study quoted](#) in the Nature supplement which counted an article’s references to journals in other fields. This count of work crossing disciplinary lines is taken as an index of creativity. Articles with at least one Chinese co-author were found to have more such references that span disciplines than other articles.

The Standing of Chinese Universities

A Share rating was also calculated by Nature Index for 500 Universities worldwide in 2022. Of [the top ten](#), 7 were Chinese and 3 American. They are:

1. Harvard University
2. University of Chinese Academy of Sciences
3. University of Science and Technology of China
4. Nanjing University
5. Stanford University
6. Peking University
7. Tsinghua University
8. Massachusetts Institute of Technology
9. Zhejiang University
10. Sun Yat-sen University

Of the top 20, 11 were Chinese; 4 were American. The Share of the 11 Chinese had all risen since 2021; the others had all declined.

Chinese Universities in 2019 [produced](#) 49,498 STEM PhD's as compared with 33,759 for the US. By 2025 it is [projected](#) that China will produce 77,179 STEM PhD's, nearly double those of the US's 39,959 then. These PhDs constitute the human capital on which a sustainable, growing science endeavor depends. In turn the ability to turn out high quality PhD students depends on an educational system that develops students for University. And here too China does not disappoint. In the OECD's (Organization for Cooperation and Development) triennial test across 79 countries involving 600,000 15-year-olds, Chinese students "far outstripped peers in every other country in a survey of reading, math and science ability" as [Forbes](#) reported. This led Forbes to headline its coverage with "China's Schoolkids Are Now Officially the Smartest in the World."

The Research and Development (R&D) Budgets of the US and China

Sustaining first rate R&D requires substantial expenditures as well as well-educated human talent. In 2022 the US R&D budget was [\\$679.4 billion](#) and China's was [\\$439 billion](#) (3.08 trillion yuan). But this dollar value for China's expenditures is calculated using the exchange rate. If we translate this into Purchasing Power Parity by a correction factor, which I calculate to be 1.7 (i.e., [the ratio of GDP-PPP/Nominal GDP for China](#)) China's expenditure is \$746 billion. (For the US, PPP-GDP and GDP are the same; the ratio is 1.) Additionally, the US R&D budget grew [5.5%](#) from 2021 to 2022 whereas China's growth rate was [10.4%](#) and has exceeded 10% for seven consecutive years.

US Efforts to Decouple from Chinese Science May Backfire

Beginning in 2011 with the "Pivot to Asia," the US has sought to weaken China and to slow or reverse its development, the euphemism for which is "containment." The US effort is military as shown by the continuing buildup of US forces in the Western Pacific; economic as illustrated by US sanctions, tariffs and export restrictions; and scientific, most recently in the Chip sanctions and most notoriously in the China Initiative targeting Chinese American scientists which continues despite having had its name expunged for cosmetic purposes. Most recently the Biden Administration moved to terminate the 43-year old US-China United States-China Protocol on Scientific and Technological Cooperation which drew a [letter of](#)

[protest](#) to the President from two Stanford physicists signed by 1000 scientists.

This has been felt in the number of Chinese-American research collaborations which [fell 15%](#) from 2020 to 2022, coinciding with the first years of the Biden administration. On top of that, the strategy does not seem to be working since China's collaborations with other leading research nations [continue to grow](#). Finally, given China's leading role in research, it remains to be seen whether China or the US will suffer more damage from this competition which really ought to be a collaboration.

Clearly, the US motive is to hold back China by isolating it from the West, but it is a sad commentary on the US that it is willing to damage science, which benefits all of humanity, to advance its goal of global domination.

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