

Top Science Cities (2019)

Last week the Nature released its *Science Cities Index* which I find to be a somewhat unusual, but informative, summary of where in the world science is actually getting done. Obviously, this effort is linked conceptually to the ever-popular academic “ranking lists” (US) or “league tables” (UK) that purport to summarize the quality of colleges/universities, academic departments, secondary schools, kindergartens according to some standard set of criteria. In terms of their accuracy, such lists are dubious at best as the ranking achieved by any institution depends



entirely on the degree of conformance between the realized strengths and effective priorities of the institutions in question and the set of characteristics used to establish the ranking. Often the latter are evaluated subjectively by a comparatively small group of evaluators whose identities, and qualifications to be members of that group, are rarely made clear. As a result, such exercises usually fail to meet scientifically acceptable standards of rigor or transparency as well as being rather easily capable of manipulation to produce virtually any outcome designed a priori. Nonetheless, such logical quibbles fail to explain the extraordinary diversity of topics for which ranking lists have been produced, much less the way they quickly become talking points around the water coolers (or now, at the ends of Zoom meetings) around the world; even among scientists. Based on this circumstantial evidence I suspect the appeal of such lists lies in what appears to be a fundamental human social need to compare themselves to other humans and other humans to one another. So, having noted these caveats, what does *Nature's* 2020 Top Science Cities Index tell us?

According to *Nature's* Catherine Armitage, its science cities were evaluated on the basis of the combined output of all institutions that publish peer-reviewed scientific articles in 82 high-quality science journals selected by a panel of 58 leading researchers as the journals to which they were most likely to submit their best work and validated by a survey of more than 6,000 researchers worldwide. Unsurprisingly, no specialist paleontological journals are included in this list though a number of general geological journals in which paleontological research articles appear regularly are (e.g., *Geology*, PNAS, PRS-B, *Science*, *Science Advances*, *Nature*). The list is dominated by *Nature* titles (22%). Among the field specific journals there is a sub-equal split between physical and biological titles (52%:48%), but almost half the latter are medical journals. And the list includes only seven (9%) of titles that could be considered “general science”. Nevertheless, the number of articles that appeared in these journals during 2019 varied widely from a high of 3088 for *Chemical Communications* to a low of 92 for *Genes & Development*. On this basis the skew is definitely in favor of the physical sciences. Still, for large metropolitan areas with a mixture of universities, research institutes and medical facilities it seems a reasonable source of comparative data, not too small to be grossly unrepresentative and not too large to introduce too many classificational complexities.

The top 10 list for 2020 (compiled for the year 2019) is both surprising and consistent.

Beijing, China
New York Metropolitan Area, USA
Boston Metropolitan Area, USA
San Francisco-San Jose, USA
Shanghai, China
Baltimore-Washington D.C., USA
Tokyo Metropolitan Area, Japan
Nanjing, China
Paris Metropolitan Area, France
Los Angeles Metropolitan Area, USA

Compared to the 2019 Index (compiled for the year 2018), the top four cities remained unchanged, Shanghai rose two levels, Baltimore-Washington, Tokyo, Paris Los Angeles, and Chicago all dropped one level, and Nanjing rose four levels. Based on these data it's difficult to avoid the impression that Chinese cities are on the rise in terms of their scientific research output and so their influence as global hubs of scientific activity. Other somewhat surprising changes over the past year include Wuhan (+6 levels), Guangzhou (+10 levels),

Hefei (+7 levels), Tianjin (+24 levels), London (stayed the same at 14), Cambridge (-2 levels) and Oxford (-2 levels). Of course, these data don't take either the population or areal sizes of the different cities into consideration. Nonetheless, performance is performance and it's worth noting that some of the top US "cities" are actually amalgams of multiple metropolitan areas (e.g., Baltimore-Washington D.C.).

Moving on to the rankings for the earth & environmental sciences, there are more surprises.

Beijing, China
 Baltimore-Washington D.C., USA
 New York Metropolitan Area, USA
 Nanjing, China
 San Francisco-San Jose, USA
 Los Angeles Metropolitan Area, USA
 Boulder, USA
 Boston Metropolitan Area, USA
 Wuhan, China
 Zürich, Switzerland

No city-level data for the previous year appear to be available from the *Nature* Index. However the presence of three Chinese cities in the top ten, alongside such traditional powerhouses as Baltimore, New York, San Francisco, and Boston, seems unexpected. Prior to the release of this table I doubt many would have listed Beijing, Nanjing or Wuhan as noteworthy global centers of earth-science research.

When I was a graduate student, back when we still lived in caves, the University of Texas at Austin was a rising star in the US academic rankings and the put-down on the older, more "established" campuses was that UT was the "best university money can buy". I'm sure something along the same lines will now be said about the rise of China's universities. However, money is, and never will be, the whole story. Today, Texas has a GDP of \$1.887 trillion, second in the US only to California and larger than the entire economies of South Korea and Canada. Yet, in 2019 Austin was listed as the 40th most productive science city whereas, in the ranking just released, it's dropped to 62, below the rankings of Daejeon (58), Montreal (44) and Toronto (31).

So, congratulations where congratulations are due. Well done Shanghai, Nanjing, Wuhan, Guangzhou, Hefei, Tianjin and all the other cities whose rankings were raised in 2019. Very good Beijing, London and all the other cities who maintained their rankings. As for those whose rankings fell, if the fall was just one or two levels it might not matter much in the long run. There's lots of variation in the system, the ranking criteria are a bit idiosyncratic and anyone - or any city - can just have a bad year. Outside this envelope, however, you might want to dig deeper into the data and try to understand the reasons for the fall a bit better. Far outside this envelope though, and assuming you care one way or the other, I'd say further investigation is a must ... and must work harder.

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23 September 2020