EDITORIAL

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Science and technology, not SciTech

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The recurrent phrase 'science and technology' ranks one ahead of the other, but the two words have been treated the same by many and, in practice, their priorities have often been swapped.

Science, more precisely natural science, refers to a system or notion of acquiring knowledge through experimentation, simulation and analysis to understand and explain natural phenomena. Within the context of this discussion, it could also include mathematical science. Technology, on the other hand, refers to the collection of techniques, methods, skills and processes that are applicable to the generation of products or services beneficial to human society.

Between the two, science provides a foundation for technology to develop. Conversely, advancement in technology continuously generates new motivation and poses new questions to science. The late great scientist Qian Xuesen (Hsue-Shen Tsien, 1911–2009) believed that there is an important component, which he named engineering science, connecting the two together.

Scientific advances have mostly been driven by human curiosity to understand the basic principles governing the natural world, rather than the desire to meet human needs. Many incidences of discovery emerged unexpectedly, beyond human prediction or planning, and they might not be recognized as such within a short time. To name a couple of examples, mathematical number theory has a 3000-year-old history but it was considered particularly useful only when it was successfully applied to modern cryptography. The esoteric theory of general relativity of Albert Einstein had been placed in Heaven but recently stepped down to Earth with the GPS application. The structure of the DNA double helix was discovered due to the curiosity of James Watson and Francis Crick about genetic inheritance, which has lately revolutionized both life sciences and biotechnology.

It thus has become clear that, in promoting science and technology, one should not take the same approach and, in particular, one should not simply borrow the ideas from technology development to pave the way for science to evolve. Methodologies and policies from technology management should not be simply applied to managing science. However, it is not uncommon today that many administrative decision makers in academia rely on their 'technological thinking' to target everything including science, believing that centralized planning, big money and fast-track promotions alike would be able to spur science to develop and excel. Furthermore, prevailing views and policies measure the values of scientific research based solely on whether it is useful in providing services to the society or whether it is able to deliver marketable products in the foreseeable future. In so doing, some long-term fundamental scientific research would be ruled out because it could be labeled 'useless' from a technological point of view, especially at its initial stage.

In responding to such science and technology governing, Helmut Schwarz, President of the Alexander von Humboldt Foundation, recently points out that 'most breakthroughs in research are not and could not be planned. Rather, they appear, like Puck, in entirely unexpected corners. Because it is the passion of individuals that sparks major discoveries or inventions, choosing outstanding people and providing intellectual freedom and generous funding are key to the success of academic institutions' (On the usefulness of useless knowledge. *Nature Reviews* 2017; doi: 10.1038/S41570-016-0001).

Notably, in the common Chinese wording of SciTech (科技), this compound abbreviation of 'science and technology' is usually understood and presented as one single subject, leading to the widespread misconception of science and technology as synonym, to be viewed and managed in the same way. This is a problem throughout the long history of China. Cumulated observations and evidence suggest that this view of SciTech may be one of the reasons that modern science did not emerge in China. In fact, most Chinese ancient advances were developed towards technology for their practical values but did not evolve into building fundamental scientific knowledge and theories. For example, the discovery of gunpowder did not lead to modern theoretical chemistry, the creation of the compass did not lead to modern electromagnetics theory or theoretical physics and the ancient Chinese remainder theorem did not lead to modern number theory in mathematics.

That technological innovations were not accompanied by the establishment of modern science has long been a big puzzle that remains for Chinese scientists and technologists to be fully unraveled which, if well resolved, might quickly lead Chinese modern science to the forefront.

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