Introduction: The COVID-19 pandemic calls for the strengthening of scientific culture

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The year 2020 was an extraordinary one for China and the world. The sudden outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has had a profound impact on diverse aspects of the world, including economies, societies and international relations. China has done immense work in epidemic prevention and control and made great contributions to the global efforts to contain the pandemic. Scientific and technological innovation have played a core role in fighting this ‘war without smoke’, and scientific culture has also demonstrated its power to inspire and unite people to overcome difficulties together. Through concrete action, scientific professionals in China have demonstrated a spirit of patriotism, innovation, truth-seeking, dedication and teamwork and shown great compassion and shared humanity. In that sense, the COVID-19 pandemic shows the importance of developing scientific culture.

Against that background, the China Association for Science and Technology and Peking University jointly organized the second China Scientific Culture Forum in June 2020. Focusing on epidemic responses and the development of scientific culture, attendees engaged in extensive exchanges and in-depth discussions on the roles of scientific culture in fighting COVID-19 and on trends in economic and social development. Based on the forum’s theme and in line with the aim of telling Chinese stories well to the world, Cultures of Science organized this special issue, featuring articles by experts from different fields that discuss new trends and new challenges in the development of scientific culture in new situations and how to advance it in the new era.

I. The role of science in fighting the pandemic

Science and technology have played important roles in COVID-19 prevention and control. For example, computed tomography scanning – which used to be a high-end technique – became a mandatory examination for every patient and even suspected patients. The application of advanced information technology made epidemiological investigation much more efficient by rapidly identifying new and suspected cases and close contacts, ensured the safety and mobility of healthy people via digital tracking and increased the reliability of epidemic trend prediction through big data.

China’s response to COVID-19 has demonstrated its rapid progress in science. After the discovery of patients with severe pneumonia of unknown origin in China, Chinese scientists took only one week to isolate the causative virus and accurately sequence its genome, exhibiting a level and efficiency that was far higher than during the 2003 severe acute respiratory
syndrome outbreak. Moreover, scientific researchers rapidly produced original, significant research results. For example, teams from Westlake University, Tsinghua University and the Institute of Microbiology of the Chinese Academy of Sciences revealed the structure of full-length human angiotensin-converting enzyme 2 protein and the structure of its complex with the S protein receptor-binding domain of SARS-CoV-2. Teams from Peking University, the Chinese Academy of Sciences and Tsinghua University used single-cell sequencing technology to screen for effective antibodies against SARS-CoV-2. Behind China’s resolute, effective and efficient measures to fight the pandemic has been the strong support of the country’s research workforce.

The tremendous power shown by science in our efforts to fight the pandemic reminds us that, in promoting scientific culture, we must believe in science, respect science, love science and hold science in high regard. At the same time, we also need to see that science is not omnipotent and, as was evident while tackling COVID-19, it has limitations. For example, there is still a lack of laboratory indicators to predict COVID-19 regression. There is still the problem of determining the accuracy of nucleic acid testing and the significance of patients who ‘return to positive’. There is still no definitive certainty about how infectious COVID-19 is during the incubation period. Efficient methods for the timely detection of asymptomatic patients are still lacking. The pathogenicity of various mutated variants of the virus is still unable to be determined. The safety and efficacy of vaccines are still uncertain, and, lastly, our understanding of the origin, evolution and intermediate hosts of the virus remains far from complete.

When faced with so many unknowns and inabilities, and when research results are proven doubtful, we understand more that science cannot solve all problems, and that science is not always correct but develops via a continuous process of falsification. At the same time, however, there is a firm belief that science will unravel the mysteries of the unknown and solve complex problems. For example, we believe that, with the advance and extensive application of science and technology, humankind will be able to establish an early warning system for emerging diseases spreading from animals to humans; that we will find methods for detecting pathogenic infections more accurately and more rapidly; that we will develop more powerful big data and artificial intelligence applications to predict the development of infectious diseases more accurately and guide the fight against epidemics; and that we will develop safe and effective vaccines and therapeutic drugs. Science gives us both strength and confidence to fight against the pandemic and tells us that there is no end to humans’ exploration of nature and ourselves.

2. The pandemic highlights the importance of scientific culture development

History suggests that scientific and technological progress and public scientific literacy are the most powerful weapons to overcome epidemics. China’s outstanding success in COVID-19 control is, to a great extent, attributable to the development of modern science and technology and the contribution of scientific professionals. Chinese scientists successfully sequenced the complete SARS-CoV-2 genome soon after its outbreak and shared research data and other relevant information pertaining to virus detection, clinical therapy, drug screening and epidemiological investigation at the first opportunity. Those actions provided valuable insight to scientists around the world fighting against the pandemic and demonstrated China’s strength in science and technology and its image as a responsible nation. Scientific professionals in China promoted scientific measures among the public and prepared various popular science materials, which played an important role in fighting the pandemic.

The COVID-19 pandemic has encouraged scientific innovations in areas of medicine and public health and brought new opportunities as well as new challenges for China to further strengthen its scientific culture. Scientific culture is an important ‘soil’ for nurturing scientific and technological innovation and is the basis for improving public scientific literacy. For a long time, a scientific culture lagging behind scientific and technological development and underdeveloped public scientific literacy have hindered the development of China’s scientific and
technological innovation, and those things underlay some irrational behaviours during the pandemic. How to improve public scientific literacy and accelerate the formation of a scientific culture that reflects China’s current scientific and technological development is a subject that calls for urgent reflection and intensified efforts.

3. Scientific spirit shown in fighting the pandemic

Through this epidemic, we have come to appreciate more that the core of scientific culture is the scientific spirit; that is, the spirit of leading scientists. In fighting the pandemic, scientists around the world exhibited the spirit of truth-seeking, honesty, innovation, criticism and tolerance. Many Western scientists refused to be bound by ideological and political shackles by seeking truth and putting facts first. For example, Johns Hopkins University has persisted in publishing factual US COVID-19 updates every day. Anthony Fauci, Director of the National Institute of Allergy and Infectious Diseases, expressed the danger of COVID-19 to President Trump in a straightforward manner, in person. The Pasteur Institute in France traced the source of the COVID-19 outbreak in Europe and released research results that contradicted many politicians. As soon as the COVID-19 epidemic hit, Chinese scientists went into action working on effective responses, exhibiting their devotion to family and country. The Chinese Center for Disease Control and Prevention (China CDC) sent a team comprising CDC personnel from across the country to Wuhan in a heroic act to confine the virus to the infected area, and the entire staff of the Wuhan Institute of Virology worked day and night for months and accomplished great things.

The COVID-19 epidemic also revealed some inadequacies in China’s scientific culture. For example, in some critical moments, some scientists failed to adhere to their scientific standpoints and uphold the dignity of science. Another example is that there was a lack of the spirit of scientific collaboration and coordination of clinical drug trials, resulting in many projects taking place at the same time, but none had a sufficient number of clinical cases or was able to arrive at a definite conclusion. That situation remained largely unaddressed despite it being raised by World Health Organization experts with respect to the remdesivir trial, with the result that multiple otherwise promising projects failed to yield important conclusions. Another weakness pertained to the spirit of innovation. Thousands of research projects were launched after the pandemic outbreak, but many of them were low-level repetitive studies. Few studies were truly original, groundbreaking or able to solve practical problems. Of course, this had to do with insufficient innovative capacity. Scientific research requires the accumulation of knowledge over a long period, and the ability to devise effective solutions in critical moments depends on previous research, which is something that cannot be generated rapidly. Lastly, China’s science and technology policy puts too much emphasis on practical and short-term effects, resulting in a substantial lack of attention to and investment in basic research, indirectly leading to an academic culture of pursuing quick success. These issues warrant further reflection.

Scientific culture encompasses a set of values, ways of thinking and codes of conduct, but it also involves institutional constraints and social norms formed by the scientific community during the pursuit of their scientific activities. The core of scientific culture is the scientific spirit, and the essence of that spirit lies in the pursuit of truth, factuality, rational questioning, empirical evidence and a requirement for universality and certainty of research conclusions. Scientists’ attitudes towards science and what they do in the course of scientific research are determining factors in the formation of scientific culture. Therefore, scientific professionals must enhance their sense of responsibility, take the lead in promoting the scientific spirit and be the practitioners, promoters and leaders in the construction of scientific culture. In the face of the rapid development of information technology and social media, scientists should shoulder the responsibility of public science communication by abiding by scientific norms, speaking on the basis of solid knowledge and proven facts rather than half-baked ideas, spreading scientific knowledge, guiding public opinion and preventing the spread of pseudoscience while advancing epidemic prevention and control.
4. Public scientific literacy put to the test in the pandemic

Through the COVID-19 epidemic, we have become more aware of the urgency of strengthening popular science and promoting scientific culture throughout society. The epidemic has provided a focal point for in-depth nationwide popular science and health-care education. With the epidemic raging and lives at risk, the general public is more concerned about public health than ever before. For the first time, many people were informed about what viruses are and how SARS-CoV-2 is transmitted, and with that understanding they consciously wore masks, practised social distancing and strictly adhered to home quarantine guidelines at the height of the epidemic. People have genuinely understood the danger of eating wild animals indiscriminately and gained a deeper appreciation for establishing good living habits and maintaining harmony between humans and nature. Public recognition of vaccines has increased rapidly, and many people have joined voluntary vaccine trials.

The COVID-19 epidemic has also tested China’s public scientific literacy. In the internet age, when anyone can be an information communicator, it often happens that people get carried away by their emotions to the extent that respect for basic facts and rational thinking are cast aside and rumours that are against basic science and common sense run rampant – a phenomenon that undermines public consensus and hinders social stability and progress. What is even more distressing is that scientists were attacked on the internet. While our scientists were working tirelessly during the epidemic, they faced slander and reckless accusations from some internet users. The various irrational behaviours exhibited during the epidemic indicate that China’s public scientific literacy requires further improvement and that scientific professionals should actively follow the scientific spirit in their activities and promote scientific culture to society as a whole.

5. Reflections on the development of scientific culture

Scientific culture is the soil in which science and technology grow, the foundation on which scientific and technological innovation take place, an important lever to improve public scientific literacy and advance cultural progress, and the basis for consensus building among countries in the process of cross-cultural exchanges. The continuous and stable development of scientific culture requires acceptance and respect for science among the whole of society and understanding and tolerance of scientists. It is important to ensure that professional science and technology bodies conduct their work and exercise their functions within the scope of their responsibilities and maintain their independence and authority.

Due to historical and other reasons, China has an underdeveloped scientific culture, which has become a serious constraint on the country’s indigenous innovation and sound development in science and technology. The COVID-19 epidemic is an important test of the development of scientific culture in China. It has helped us further identify issues and areas of weakness, strengthened our conscientious initiative to develop scientific culture and will greatly boost the development of the country’s scientific culture. Scientific professionals should, under the leadership of the Central Committee of the Communist Party of China with General Secretary Xi Jinping at its core, work more proactively to advance the scientific spirit and promote the development of scientific culture.

Declaration of conflicting interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

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