Introduction to history of science special section on tong

Introduction to History of Science Special Issue on *tong* 通

Volker Scheid & Curie Virág

Writing on science and China invariably invokes references to and comparison with the West. Which, in turn, demands some reflection on what we mean by science and how we might approach its history. By now, it has become widely recognised that such reflection itself has a history, a history that defines the study of science in China and links it to the history of science, technology and medicine at large. In recognition of the figure who has contributed most significantly to the field, this history can be divided into three stages centred around Joseph Needham's pathbreaking *Science and Civilisation in China* project, the first volumes of which date to the late 1950s.

Before Needham, science was considered a uniquely Western accomplishment in both China and the West. Writers from Matteo Ricci to Voltaire, Bertrand Russell, and Albert Einstein - but also Chinese modernisers across the political spectrum - castigated China for its tradition of backwardness, and its lack of interest in logic, experimentation and industrialisation. Needham challenged this consensus with his concept of a 'grand titration', meticulously documenting China's many significant contributions to the great river of modern science in a series that by now spans over thirty volumes.[1]

Yet, by substituting the narrative of a grand divide between the West and the rest with a temporal one that divided science into ancient/local and modern/universal, Needham did not ultimately go beyond the dualist constitution and teleological narrative of modernity. This is revealed not merely in the famous Needham question (which asks why modern science only arose in the West), but also in Needham's less well-remembered efforts to divide modern science itself into two complementary currents: a reductionist strand associated with cause and effect reasoning and exemplified most clearly in logic, mathematics and physics and an organicist strand concerned with complex wholes and exemplified by biology. Needham traced the emergence of this organicist strand back to Leibniz, who he (falsely) believed had been influenced by Neoconfucian ideas about the order of Nature, and constructed for it a chain of transmission that extended from the Chinese philosopher Zhu Xi via Leibniz to Herder, Schelling, Lotze, Hegel, Marx, Engels, Whitehead, the German holistic sciences of the late 19th and early 20th centuries, the holism of Jan Smuts, and contemporary attempts to understand complexity.[2]

Needham's ideas closely mirrored those of his contemporary C. G. Jung, who in the late 1940s already had detected similarities between Chinese ideas of resonance (another of Needham's key concepts demarcating Chinese science) and Western quantum physics.[3] In the 1970s and 80s, China thus came to be associated in the writings of popular science writers like Fritjof Capra and Gary Zukav with a science that was at once ancient and ultra-modern.[4] Despite these attempts to find the East in the West (and vice versa) , the study of the scientific tradition in China remained deeply attached to a modernist discourse that opposed the analytic rational West with an exoticised, intuitive East.[5]

The third or post-Needham stage of our engagement with Chinese science thus originates with a more explicit engagement with the narrative of the great divide itself. Here, the seminal figure is Nathan Sivin, who became critical of Needham's wholesale comparison of scientific traditions and proposed, instead, to focus on the plurality of diverse local traditions that historically emerged out of each other without imposing on them any *a priori* master narrative.[6] Such narratives included Needham's thesis of a Confucian disinterest in practical matters but also the more general assumption, inherited from the wider history of science, that science was the precondition for technology, which would mean that China's failure to develop a modern science also explained its failure to undergo an industrial revolution.

In accordance with this approach, Sivin's students and their students, as well as scholars influenced by his work, have attempted to write the history of science, technology and medicine in China without privileging modern definitions of science or reading them back into Chinese history. Seeking to free themselves from the influence of positivist and nationalist histories, historians of medicine in Taiwan, for instance, have adopted an anthropological approach that sought to treat "the past as a foreign country,"[7] while western historians of science in China have attempted to write that history anew but this time "on their own terms."[8] The work of these scholars, of course, addressed not merely narrow disciplinary problematics but reflected wider intellectual shifts within the history of science, where 19th century positivist notions of a singular science and cold-war Kuhnian models of distinctive and clearly-demarcated scientific paradigms were giving way by the 1980s to acknowledgements of the fundamental disunity of science and a research focused on local practices and disputes.[9] Indeed, an increasing number of younger researchers has explicitly linked their own work to that of science and technology studies (STS), historical epistemology, or the more recent ontological turn in anthropology and science studies.[10]

Yet, the power of modernist dichotomies in the contemporary world remains too deeply entrenched for them to disappear by mere intention. For instance, while the strong program in science studies and its successors, most notably Bruno Latour's actor network theory (ANT), was established with the specific goal of overcoming the great divide, few mainstream STS researchers in have shown any real interest in exploring non-Western/non-modern domains of practice.[11] Even more importantly, while the focus on local networks, and on breaks, ruptures and transformations that has been imported into the study of Chinese science, technology and medicine from fields like STS and historical epistemology does, indeed, advance the field beyond earlier conceptions of an unchanging tradition, it, too, remains wedded to a distinctly modern conceptualisation of history and time. For the very demand for a difference to exist between past and future, for the flow of time to be interrupted by a series of crises that create a critical response, for "history" to emerge as a discipline, and for us to know the world as history: all of that, as Koselleck has shown, flows from a distinctive Enlightenment ethos that emerged in the 18th century and that continues to inform our thinking today. [12]

Capturing history on "their own terms", is also an enterprise fraught with many more problems than may at first appear. For whose terms precisely are "their" terms? One criticism, certainly, that may be made of Benjamin Elman's pathbreaking study of early modern Chinese science, is that in attempting to create some kind of equivalence between the Neoconfucian interest in things and early-modern science, one privileges some voices over others, including attempts by these voices to write history precisely on their own terms.[13] We therefore argue that while it is essential to study "their history" on and through "their own terms, " these terms should not be determined *a priori* by a perceived need for comparison with modern science but rather emerge from a reading of the sources themselves. To this end, the two papers collated in this issue explore how a single term - *tong* 通 - variously orients and thereby connect thinking and practice in late imperial China in domains extending from philosophy and commerce to medical innovation and the circulation of knowledge and things.

Tong (which can function as a noun, a verb, or an adjective) translates roughly and variously into English as "flow," "penetration," "movement," "circulation," "communication," "connection," and "comprehensiveness." Within the history of science, *tong* is most familiar from its use in traditional Chinese medicine, as an attribute of sound, properly functioning bodies whose ceaseless, sustaining process of flow and circulation accords with a vision of an animated, dynamic cosmos. Yet *tong* appears also in treatises on ethics and natural philosophy, as well as in discourses on literary,

economic, and political thought. As a structural attribute, *tong* denotes comprehensiveness, universality, and commonality; as a dynamic quality, it refers to movement, connectivity, and penetration. In this latter aspect, *tong* affirms the vital importance of human movement and activity as well as the movement, interaction, development, and unfolding of things. It is, in other words, an essential dynamism of continuous, necessary change in the world and in its perception.

The semantic range and the multivalence of *tong* thus give us access to scientific thought not only as objectified knowledge, materialised in schematic and intelligible structures, but as a human activity. That is, *tong* represents a crucial quality of the process of knowing itself, and points to the active engagement of human intelligence in the pursuit of understanding. For Chinese thinkers over the centuries, optimal knowing (denoted by *tong*) enters and travels through the structure of things, and at the same time navigates inwards and outwards to envision structural unities, to contain them, and to become contained by them. *Tong* therefore captures a full cycle of cognitively significant experiences - experiences that do not privilege a passive reception of structural forms, but that instead draw attention to the moving agency of human beings in their quest to achieve knowledge of the world.

This is not to deny that structural synthesis constituted an important part of the historical development of Chinese thinking about the natural world, or to assert that Chinese thinkers did not endeavour to grasp the order of the world in the form of visually ordered wholes. Historians of Chinese science have indeed foregrounded efforts at discovering and describing structures, most notably the map-like schematisations of cosmic correlations that achieved elaborate formulation during the Han Dynasty (206 BCE – 220 CE). In *Science and Civilisation in China*, the pioneering study of the history of science and technology in China, Joseph Needham traces the beginnings of the very interest in natural science to Zou Yan (ca. 350 BCE – ca. 270 BCE), "the real founder of all Chinese scientific thought," whom he credits with creating a comprehensive, systematic picture of the world out of a theory based on the interlinked dynamics of *yin, yang*, and the Five Phases (*wuxing*).[14] Similarly, Nathan Sivin identifies naturalistic thinking in China with the correlative cosmologies that came to be formulated around the 3rd century BCE, which envisioned the cosmos, the state, and the human body as part of a single, integrated, and mutually resonant whole. This schematic comprehensiveness of early Chinese scientific thought is epitomised by the *Inner Cannon of the Yellow Emperor* (*Huangdi neijing*), an encyclopaedic imperial medical compendium.[15]

These comprehensive and totalising approaches cannot, however, be taken as representative of Chinese scientific or naturalistic thinking in general. Instead, we might regard them as a particular

way of making sense of the world that resonated most strongly in certain periods - periods marked by a heightened search for unity in both the practical and the conceptual domains. The structural approach to Chinese science thus captures one aspect of a more diverse, evolving tradition in which the visual mapping of reality as structured wholes was one of a variety of proposals put forth by thinkers endeavouring to explain the reality of the world.

An investigation of *tong*, then, expands our understanding of what we might call "scientific" thought in China. Such an investigation reveals the structural and dynamic qualities of scientific thought as well as its descriptive and normative implications. It shows us not only the forms of scientific understanding but also its underlying logic. And it gives access to traditional Chinese conceptions of knowledge, both as products of human thinking and as the experience of engaging with and making sense of the world. Encompassing the common frameworks and patterns of thought that transcend and connect domains that modern academics have assigned to separate subfields and disciplines – ethics and calligraphy, hydraulics and governance, hermeneutics and astrology – the senses and meanings of *tong* can preserve the contours of traditional Chinese thought and argumentation, and the values that guided their development.

Moreover, whereas histories that emphasise schematic structures situate Chinese scientific thought along the yardstick of Western conceptions, a history that approaches Chinese science through the dynamic epistemology of *tong* – that is, a history that takes *tong* as both the object and as the method of its inquiry – offers materials for a critique of the history of Western scientific thought. *Tong* overcomes categorical divisions that our current, Western framework of scientific understanding has accepted as dichotomous. As argued above, *tong* encompasses both structure and dynamism. It also joins together discourses of the cosmic and the human. Premised on the idea that things, in their properly functioning state, should exemplify connectedness, fluidity, and unobstructed movement through space, *tong* was a criterion of soundness not only for the realm of "nature" more broadly, but also for human beings, both in the physical workings of their bodies and in their cognitive capacities. Just as things in their proper state were to be flowing, pervading, and moving through, so was a person of "perspicacious" (*tong*) intelligence free from blockage and limitations, and able to "penetrate" or "comprehend" the Dao (*tong hu dao*). Such free-flowing intelligence ultimately achieved knowledge that was *tong*: unified, coherent, and all-encompassing.

Despite its central importance in Chinese thought, the term *tong* has not been the object of sustained scholarly inquiry. It has received some attention in the study of traditional Chinese medicine, but outside of this context it has not been proposed as a topic for investigation, much less

as a method of inquiry or a means of epistemological critique. By focusing on *tong*, the two papers collected in this special issue of *History of Science* provide new insights into the nature of scientific thinking in China, demonstrate shared cognitive underpinnings in varied branches of inquiry, and rediscover moments of structural epistemological reorientation – moments at which thinkers proposed fundamentally new explanations for the patterned workings of the world, and adjusted their practical engagements with that world to accord with those new explanations. An historical inquiry that is attentive to the shifting meanings and discourses of *tong* will therefore reveal major shifts in the development of scientific understanding and in the very conception and organisation of knowledge, including the period during which *tong* gained currency as a defining attribute of higher intelligence, around the 4th century BCE, when thinkers first recognised the human capacity for higher understanding about the world.

The essay by Christian de Pee shows that Chinese thinkers in the eleventh and twelfth centuries returned to that classical period of Chinese thought in hopes that early thinkers might guide them in penetrating and assimilating the immanent, dynamic patterns that the profusion of commercial activity, the virulence of political strife, and the variety of printed knowledge had obscured to them. Volker Scheid argues, similarly, that the physician Ye Tianshi (1664-1746) developed a new, spatial approach to the human body that succeeded simultaneously in confronting an epidemiological crisis, synthesizing divergent strands of the medical tradition, satisfying the demands of local patients, and maintaining universal conceptions of bodily structure and function.

By examining trajectories of development rather than establishing a series of static schemata, and by encompassing patterns of thinking that exceed the traditional contours of the history of science, the present inquiry can provide a basis for non-essentialising forms of comparative historical inquiry across scientific and epistemological traditions. At the same time, it has philosophically significant implications for understanding the nature of our own thinking and knowing, and of the very conceptual resources by which we achieve such understanding. If we return to the basic fact of the semantic multivalence of *tong*, and keep within view its development from an ordinary, descriptive term denoting the conditions of things in the world to its eventual application to the workings of human intelligence in comprehending those conditions – we can well appreciate the extent to which our tools for making sense of our own cognitive processes, and eventually our ethical potentialities, are rooted in our assumptions about the workings of the physical world, a world that is nevertheless animated with spirits and other mysterious forces that move things towards their optimal realisation.

Endnotes

[1]. Joseph Needham, The Grand Titration: Science and Society in East and West (London, 1969). For a list of volumes in the *Science and Civilisation in China* series see http://www.nri.cam.ac.uk/science.html.

[2]. Joseph Needham, *Science and Civilisation in China: History of Scientific Thought*, ed. J. Needham (Science and Civilisation in China, vol. 2, Cambridge, 1956), p. 291.

[3]. An outline of the as yet under-examined process by which Western ideas of organicism or holism were imposed onto Chinese science and medicine can be found in Volker Scheid, 'Holism, Chinese medicine and systems ideologies: rewriting the past to imagine the future', in Angela Woods and Anne Whitehead, eds., *The Edinburgh Companion to the Critical Medical Humanities* (Edinburgh 2016), pp. 68-87. See also E. Slingerland, 'Body and Mind in Early China: An Integrated Humanities-Science Approach', Journal of the American Academy of Religion, 81 (2013), pp. 6-55.

[4]. Capra, Fritjof, *The Tao of Physics: An Exploration of the Parallels Between Modern Physics and Eastern Mysticism* (Berkeley, 1975); Zukav, Gary, *The Dancing Wu Li Masters* (London, 1979).

[5]. Benjamin A. Elman, John B. Duncan, and Herman Ooms, *Rethinking Confucianism: Past and Present in China, Japan, Korea, and Vietnam* (Los Angeles, 2002)., Harriet Zurndorfer, 'La Sinologie immobile - Note critique', *Etudes Chinoise*, 8 (1989), pp. 99-12.

[6]. Nathan Sivin, 'Why the scientific revolution did not take place in China - Or didn't it?', *Chinese Science*, 5 (1982), pp. 45-66; Nathan Sivin, 'Science and Medicine in Imperial China - The State of the Field', *The Journal of Asian Studies*, 47 (1988), pp. 41-90; Nathan. Sivin, *Science in ancient China: researches and reflections* (Aldershot, 1995.).

[7]. Jender Lee, 'The Past as a Foreign Country: Recent Research on Chinese Medical History in Taiwan', *Disquisitions on the Past and Present,* 11 (2004), pp. 37-58.

[8]. Benjamin A. Elman, *On their own terms: science in China, 1550-1900* (Cambridge, Mass., 2005).

[9]. Jan Golinski, 'Is it time to forget science? Reflections on singular science and its history', *Osiris*, 27 (2012), p. 30-32.

[10]. The journal *East Asian Science, Technology and Society: An International Journal (EASTS),* founded in 2006, is a key location for the publication of such research. Other examples include the work of Francesca Bray, *Technology and gender: fabrics of power in late imperial China* (Berkeley, 1997); Francesca Bray, 'Science, technique, technology: passages between matter and knowledge in imperial Chinese agriculture', *Brit. J. Hist. Sci.*, 41 (2008)., Howard H. Chiang, 'Rethinking 'style' for historians and philosophers of science: converging lessons from sexuality, translation, and East Asian studies.', *Studies in History and Philosophy of Biological and Biomedical Sciences*, 40 (2009 Jun), pp. 109-118; Howard Chiang, *Historical epistemology and the making of modern Chinese medicine* (Manchester, 2015)., Judith Farquhar, *Knowing Practice: The Clinical Encounter in Chinese Medicine* (Studies in the Ethnographic Imagination, Boulder, 1994)., Sean Hsiang-lin Lei, *Neither Donkey nor Horse: Medicine in the Struggle over China's Modernity* (Chicago, 2014)., Dagmar. Schäfer, *The crafting of the 10,000 things : knowledge and technology in Seventeenth-Century China* (Chicago, 2011)., and Volker Scheid, *Chinese Medicine in Contemporary China: Plurality and Synthesis* (Durham, 2002).

[11]. A notable exception is Wen-yuan Lin and John Law, 'A correlative STS: lessons from Chinese medical practice', *Social Studies of Science*, 44 (2014), pp. 801-824.

[12]. Reinhart. Koselleck, *Studien zum Beginn der modernen Welt* (vol. Industrielle Welt ; Bd. 20, Stuttgart, 1977); Reinhart. Koselleck, *Critique and Crisis: Enlightenment and the Pathogenesis of Modern Society* (Cambridge, Mass., 1988).

[13]. An example on which one of us has recently stumbled, more or less by accident, is the systematic exclusion of Buddhist voices from the history of medicine in early modern China, including their definition by Elman as belonging to the realm of popular or religious medicine. Volker Scheid, 'Between Warfare, Poetry and Enlightenment: The Life and Work of Yu Chang 喻昌 (1585-1664) as a Window on Medicine and Early Modernity in Seventeenth Century China - and on the Biases of Historians', (forthcoming).

[14] Needham, *Science and Civilisation in China: History of Scientific Thought*, p. 232.

[15] Nathan Sivin, 'IV. The Myth of the Naturalists', in *Medicine, Philosophy and Religion in Ancient China. Researches and Reflections* (Aldershot, Hampshire, Great Britain: Variorum, 1995), pp. 1-33; N. Sivin, 'State, Cosmos, and Body in the Last Three Centuries B.C.', *Harvard Journal of Asiatic Studies*, 55, June 1995, pp. 5-37. John B. Henderson similarly equates "cosmology" with "correlative thinking" that links the body, cosmos and state within a system of correspondences. In J.B.

Henderson, 'Cosmology and Concepts of Nature in Traditional', in Hans Ulrich Vogel and Günter Dux (eds.), *Concepts of Nature. A Chinese-European Cross-Cultural Perspective* (Leiden: Brill, 2010), p. 181.