

Artemisinin and Chinese Medicine as *Tu* Science

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The story of discovery of artemisinin highlights the diversity of scientific values across time and space. Resituating artemisinin research within a broader temporal framework allows us to understand how Chinese drugs like *qinghao* came to articulate a space for scientific experimentation and innovation through its embodiment of alternating clusters of meanings associated with *tu* and *yang* within scientific discourse. *Tu* science, which was associated with terms like native, Chinese, local, rustic, mass, and crude, articulated a radical vision of science in the service of socialist revolutionary ideals. *Yang* science, which signified foreign, Western, elite, and professional, tended to bear the hallmarks of professionalism, transnational networks in education and training, and an emphasis on basic or foundational research. With respect to medical research, the case of artemisinin highlights how the constitution of socialist science as an interplay of *tu* and *yang* engendered different scientific values and parameters for scientific endeavor. Modern medical research in Maoist China could harness the productive energies of mass participation to technical expertise in its investigations of Chinese drugs, and under the banner of *tu* science, it became possible and scientifically legitimate to research Chinese drugs in ways that had previously provoked resistance and controversy.

Introduction

The discovery of artemisinin has been presented as a tale resplendent with ingenuity in the face of adversity, social commitment to the good of humanity, genuine esteem for past wisdom, and a heartfelt belief in the value of science. Known in Chinese as *qinghaosu* (青蒿素) and derived from sweet wormwood (*Artemisia annua* L.), artemisinin is the active chemical substance extracted from the Chinese herb *qinghao* (青蒿). That it should be discovered by a young female medical chemist against the backdrop of the Cultural Revolution (1966–1976) and the Vietnam War, as part of a military-supported anti-malarial campaign called Project 523, only accentuates the sense of wonder accompanying the discovery. According to Tu Youyou 屠呦呦 (1930–), who received a Nobel Prize for the discovery

of artemisinin in 2015 and has become the face associated with the achievement, it happened as follows:

On the basis of collection and analysis of traditional prescriptions, my research group screened over two hundred herbs and three hundred and eighty extracts from them using malarial models of mouse or monkey. I was enlightened by the description, “a handful of *qinghao* immersed with 2 liters of water, get juice and drink it” (Ge Hong, 1956). The antimalarial effect of *qinghao* was gradually cleared up when temperature, enzymolysis, solvents, species, portions, and collecting season of the herb were systematically considered. A new antimalarial was developed in 1971, based on scientific analysis of antimalarial nature of *Qinghao* with its history of over one thousand years. The new drug won the national award of invention, and brings benefit to the people of the world.¹

Tu's description has become the standard account for the discovery of artemisinin. Her receipt of both the Lasker–DeBakey Award for Clinical Medical Research in 2011 and the Nobel Prize in Medicine in 2015 has reaffirmed this account, within which several details have been repeated with varying degrees of flourish in all subsequent accounts: the longevity and integrity of traditional Chinese medicine; the integration of traditional medical knowledge with that of biomedicine; and the unassuming power of a single insight in the production of scientific knowledge. As a story we can now tell about the advancement of science, Tu Youyou's discovery of artemisinin has been molded into the shape of any other story within the medical canon—stories like John Snow's identification of the Broad Street pump as the source of an 1854 cholera outbreak or Ignaz Semmelweis's observation that washing one's hands with anti-septic after working with cadavers and before delivering a child significantly reduced the likelihood of maternal death.

But what does the story of Tu's discovery tell us about Chinese science in both its socialist and reform era iterations? It may be surprising for an English-speaking

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¹ Tu Youyou, “The Development of the Antimalarial Drugs with New Type of Chemical Structure – Qinghaosu and Dihydroqinghaosu,” *Southeast Asian Journal of Tropical Medicine and Public Health* 35, no. 2 (June 2004): 250–51, on 250.

audience to learn, but Chinese acclaim for Tu Youyou and her achievements has been stinting and riddled by expressions of dissatisfaction and discontent, even after she was awarded the Nobel Prize in Medicine in 2015. International acclaim of Tu Youyou sparked domestic concern and criticism that she alone should receive such celebration.² Her receipt of the State Preeminent Science and Technology Award, the highest scientific honor in China, on January 9, 2017, can be seen as official acknowledgement of her accomplishments, but it has not dampened the expression of diverging opinions. How, it has been asked, can a “three no’s” (*san wu* 三無) scientist—that is someone with no postgraduate degree, no overseas training, and no membership to the Chinese Academy of the Sciences—be the representative face of Chinese medical achievement?³ Some have challenged her role as *the* discoverer.⁴ Even the story of her discovery has encountered strident criticism for its perceived overemphasis of individual merit and failure to recognize the contributions of the other scientists involved.⁵ This apparent consternation and self-reflection suggests that reform era iterations of Chinese science—however superficially they may resemble global science—retain points of idiosyncratic particularism that we need to take seriously.

This essay explores how the discovery of artemisinin illustrates the diversity and malleability of scientific values across time and space. Resituating artemisinin research within a broader temporal framework allows us to see how Chinese drugs like *qinghao* came to articulate a space for scientific experimentation and innovation through its embodiment of alternating clusters of meanings associated with *tu* and *yang* within scientific discourse. Mao-era scientific and political discourse regularly invoked the importance of *tu* (土) over *yang* (洋). The former, which was associated with terms like native, Chinese, local, rustic, mass, crude, and others, articulated a radical vision of science in the service of socialist revolutionary ideals. The broad masses were to play a formative role in the production of scientific knowledge, and through *tu* science, Mao-era China sought to actualize its commitments to self-reliance,

mass mobilization, and practical application.⁶ *Yang*, in contrast, signified foreign, Western, elite, professional, and similar qualities, and *yang* science tended to bear the hallmarks of professionalism, transnational networks in education and training, and an emphasis on basic or foundational research.

Because the scientific work involved in Maoist drug research straddled multiple realms: laboratory-based medical research, textual analyses of traditional materia medica books and collectanea, and popular mobilization in the name of public health, re-examining the history of artemisinin research as not just a component of modern Chinese medical history, but as an integral part of the history of modern Chinese science affords us a unique perch from which to consider the relationship between Chinese STM (science, technology, and medicine) and the Cultural Revolution. Indeed, a closer exploration of *tu* science, as evidenced by Project 523, forces us to confront how different valuations of what constituted science during Cultural Revolution generated both epistemological and methodological possibilities otherwise foreclosed.

Thinking Through Variances with *Changshan* Research

To understand how specific practices and approaches integral to Project 523 reflected different political valuations of science as *tu* science, it is worth setting up a point of comparison. In the 1940s, as Sean Lei has argued with respect to Nationalist medical research on *changshan* (常山), how one studied Chinese drugs articulated different political commitments about the relationship between Chinese medicine and modernity.⁷ *Changshan* is a febrifuge made from a hydrangea that has a long reference record going back to the earliest materia medica, the *Canon of the Divine Husbandman's Materia Medica* (*Shennong bencaojing*, compiled in the first or second century AD). Although the efficacy of *changshan* could be extrapolated from a literature review of Chinese prescriptions for the treatment of malaria—*changshan* was an ingredient in one of the four major traditional methods for treating malaria—practitioners of Western medicine were hesitant to trust Chinese drugs “unless they had successfully been ‘translated’ into the socio-technical network of biomedicine.”⁸ Translation, however, required a process of re-networking in which Chinese drugs were disassociated from their traditional network

² An intriguing comparison can be made between Tu Youyou and Yuan Longping. Although the latter has become celebrated as China's most famous agricultural scientist for his invention of hybrid rice, similar concerns have also been raised and would likely take a similar form should Yuan Longping ever be awarded the Nobel Prize. See Sigrid Schmalzer's essay, “Yuan Longping, Hybrid Rice, and the Meaning of Science in the Cultural Revolution and Beyond,” in this issue. I want to thank Sigrid for bringing this point to my attention.

³ See, for example, “Zhongguo dalu kexuejia shou huo Nuobei'er kexuejiang xueshu taolun' zhuanlan,” *Ziran bianzhengfa tongxun* (January 2016), <http://www.cnki.com.cn/Article/CJFDTotat-ZRBT201601001.htm>.

⁴ The issue of attribution is complicated. The social and political climate during the Cultural Revolution emphasized collective endeavor, and in the realm of scientific research, individual authorship was neither esteemed nor practiced in publications. This applies to Tu Youyou, who was not individually named in the original Chinese publications on artemisinin. For a more detailed consideration of how authorship, single or collective, factors into shifting valuations of *tu* science, see Sigrid Schmalzer, *Red Revolution, Green Revolution: Scientific Farming in Socialist China* (Chicago: University of Chicago Press, 2016), 78–80.

⁵ This is not to suggest there has been little or no recognition of her work or its potential significance for traditional Chinese medicine. For a more positive assessment as well as supporters of her achievement, see, for example, Li Bin's Q & A with six Chinese medical practitioners in “Zhongyiyao shi yige weida baoku,” in Rao Yi, Zhang Daqing, and Li Runhong, *Youyou you hao: Tu Youyou yu qinghaosu* (Beijing: Zhongguo kexue jishu chubanshe, 2015), 126–30.

⁶ The best treatment of *tu/yang* binary can be found in Sigrid Schmalzer, *Red Revolution, Green Revolution: Scientific Farming in Socialist China* (Chicago: University of Chicago, 2016). Although the terminology is different, Miriam Gross explores similar terrain in her notion of “grassroots science.” Gross, however, juxtaposes “grassroots science” against “normative science,” which presumably involves standard scientific criteria, such as reproducibility or control groups. This distinction makes sense given her focus on Mao-era anti-schistosomiasis campaigns, but by this measure, the concept of “grassroots science” is insufficient for understanding artemisinin research, because the researchers involved were committed to and believed themselves to be engaged in “normative science.” Miriam Gross, *Farewell to the God of Plague: Chairman Mao's Campaign to Deworm China* (Berkeley: University of California Press, 2016).

⁷ The People's Republic of China was established in 1949. From 1912 until 1949, China was a constitutional republic under the leadership of the Nationalist party (also referred to as “KMT” or “GMD”).

⁸ Sean Hsiang-lin Lei, *Neither Donkey nor Horse: Medicine in the Struggle over China's Modernity* (Chicago: University of Chicago Press, 2014), 201.

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