Traditionality and Lab Work:

Anti-Cancer Drug Research in Mao's China

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SUMMARY: This article opens a window on anti-cancer drug research using "traditional Chinese medicine" (TCM) in Mao-period China. Drawing on a database of over 120 scientific journal articles from that period, it discusses how physician-researchers mined Chinese materia medica for cancer cures in the context of political and practical imperatives. Some results were productive, though the interpretive possibilities of assigning credit to traditional/Chinese or Western/modern medicine in any particular instance remained broad. The article examines how extending or withholding traditionality to substances that made a seeming transition from that realm to modern clinical use was negotiated in different instances. It also locates Chinese pharmaceutical research, for the first time, in the larger context of global bioprospecting for anti-cancer drugs, which was characteristic of the 1960s and 1970s.

KEYWORDS: traditional Chinese medicine, TCM, anti-cancer drugs, bioprospecting, Cultural Revolution, pharmaceuticals, Mao's China

Under the title "Chairman Mao's Cure for Cancer," the *New York Times Magazine* reported in 2001 that a drug sourced from Chinese folk medicine during the Cultural Revolution had received U.S. Food and Drug Administration (FDA) approval to help fight leukemia. Originally named Drug 713, it had been used since the 1970s at a hospital in Harbin, in China's far northeast, where its success against leukemia and other maladies had come to the attention of Shanghai cancer specialists in the 1990s. According to the interview with Harbin doctor Zhang Ting Dong, the origin of the drug lay in a journey he and others made in 1972 to visit a poor rural practitioner of Chinese medicine in a remote Manchurian village, who was curing people using his own mixture of two kinds of powdered rock and the venom from a species of toad. Bringing the mixture back to his lab and experimenting with it on patients, Zhang determined that only one of the two powdered rocks was an effective curing agent and that its active component was arsenic trioxide. The other rock contained mercury, which was too toxic, and the toad venom only increased patients' blood pressure. Eliminating the last two ingredients and reducing the compound to arsenic trioxide alone, Zhang administered it in the form of injections, with good results.[1] The formula became "Drug 713" in his hospital, "ATO" in scientific papers published in Shanghai and elsewhere, and, nearly three decades later, with U.S. FDA approval, "Trisenox," now manufactured and sold worldwide by Israel-based Teva Pharmaceutical Industries Ltd.[2]

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[1] Elisabeth Rosenthal, "Chairman Mao's Cure for Cancer," *NYT Magazine*, May 6, 2001, sec. 6, 70. We thank Chadwick Wang for alerting us to this article and for pointing out that it incorrectly names the drug 731 instead of 713.

[2] The most detailed picture of Zhang's research is Yi Rao, Runhong Li, and Daqing Zhang, "A Drug from Poison: How the Therapeutic of Arsenic Trioxide on Acute Promyelocytic Leukemia was

Drug 173/ATO/Trisenox was rare in making the transition from a Mao-era pharmaceutical to an element in the current global medicine cabinet. But it was not unique. The most famous example is Artemisinin, the antimalarial drug for which Dr. Tu Youyou was awarded a Nobel Prize in 2015, and which was similarly the product of lab research during the period of the Cultural Revolution (i.e., 1966 to the death of Mao in 1976). Because Artemisinin was isolated in a laboratory as the active molecule within a Chinese herb, however—rather than the herb itself or as part of a polyherbal recipe of the kind that is fundamental to the traditional practice of Chinese medicine—its identity as an emblem of tradition became a source of debate in the aftermath of the award.[3] Dr. Tu described the drug as "a gift from Chinese medicine," meaning traditional medicine, though the Nobel Prize committee made no reference to its origin in indigenous materia medica. A member of the committee, Dr. Hans Forssberg, emphasized the point in a news conference when an Indian reporter asked if the award indicated the ascendency of indigenous over Western medicine: "We are not giving the prize to traditional medicine; we are giving the award to a person who has been inspired by traditional means and developed a new drug."[4]

Likewise, in the story that Dr. Zhang told about Drug 713/ATO, the old practitioner's

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Discovered" *Sci. China Life Sci.* 56 (June 2013): 495–502.

[3] Liz P. Y. Chee, "Formulating 'New Drugs' within Traditional Chinese Medicine: Inside Guangzhou Huahai Pharmaceuticals Co., Ltd." in *Asian Medical Industries: Contemporary Perspectives on Traditional Pharmaceuticals*, ed. Stephan Kloos and Calum Blaikie (London: Routledge, 2022).

[4] Quoted in Yi Rao, Daqing Zhang, and Runhong Li, *Tu Youyou and the Discovery of Artemisinin* (Singapore: World Scientific, 2016), 105; for a nuanced analysis of Tu's process and the controversy surrounding it see Elizabeth Hsu, "Reflections on the 'Discovery' of the Antimalarial Qinghao," *Brit. J. Clin. Pharma.* 61, no. 6 (June 2006): 666–70.

folk medicine compound—muddy, complex, and toxic—is pulled apart, reduced in complexity, and rendered safer through extensive laboratory trials, so that in the end only one highly refined injectable fluid remains. Yet in celebrating Zhang—who was also showered with recognition and honors in the aftermath of Tu's Nobel—the "thousands of years of experience of the Chinese people" (as Chinese medicine is often characterized) became the most relevant time period for contextualizing his achievement, and almost never the more circumscribed one of the Cultural Revolution.[5]

This article addresses the issue raised by these and similar cases, namely, how "traditionality" has been negotiated in translating Chinese materia medica into new drug therapies for a domestic and (eventually) global pharmacy. It does so by opening a window into the specific milieu from which Drug 713 emerged: the integration of traditional Chinese medicine (hereafter CM)[6] into anti-cancer drug research in the early Communist period

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[5] In a 2015 survey of Chinese medical specialists on "the top five innovations on the Chinese mainland since the 1911 Revolution," Drug 713/ATO was ranked second after Artemisinin. The authors stated that "arsenic trioxide has long been of interest, dating to traditional Chinese medicine," and later referred to the investigation of "traditionally used Chinese medicine arsenic trioxide" but failed to summarize how it had been innovated. Yi-Xiang J. Wang and Fan Xiao, "The Top Five Innovations on the Chinese Mainland since *Xinhai* Revolution [1911]: Results of AME Survey," *Quant. Imaging Med. Surg.* 5, no. 3 (June 2015): 458. One 2011 article exclaimed that "the world has learned the greatness of traditional Chinese medicine" through Zhang's research. Xu Zhiguo, "Zhang Tingdong: A Lifelong Pursuit," *Sci. News*, September 7, 2011. For a more nuanced account see Rao, Li, and Zhang, "Drug from Poison" (n. 2).

[6] We use "Chinese medicine" (CM) in preference to "traditional Chinese medicine" (TCM) because the former is a direct translation from the Chinese *zongyi*. The placement of "traditional" before CM in English and other foreign translations has been described by Kim Taylor as a "cultivated misunderstanding," which this article aims to help clarify. We use "Western medicine" (*xiyi*) as a synonym for biomedicine in China, where appropriate, again following the common Chinese usage. Like many historians before us, we are aware of the complexities raised by all these terms and refer readers to book-length studies that discuss nomenclature and translation in more detail than we can here, including Sean Hsiang-lin Lei, *Neither Donkey nor Horse: Medicine in the Struggle over*

(1950–1979). It's important to note that much Chinese lab-based drug discovery in this era paralleled Soviet (and Western) analysis of organic and inorganic chemical compounds without any reference to traditionally used herbs or animals at all. Starting in the Great Leap Forward, however, and more strongly in the Cultural Revolution, political imperatives turned more and more drug discovery projects toward indigenous materia medica, including folk medicine. This sometimes resulted in breakthroughs, as in the case of Drug 713, or promising leads that continued to be pursued into this century. In other instances, however, this emphasis on ethnopharmacology potentially stymied bioprospecting on promising Chinese botanicals that existed outside classical or folk pharmacies. Even when traditional knowledge was the legitimate spur for a research project, the final result was almost always to transform its objects in both form and purpose.

In using the term "traditionality," we mean to highlight a particular way of framing a process or object, which may or may not relate to its origins. Mao famously directed that Chinese and Western medicine learn from one another to the point of integration, despite their very real differences, and this initiative had become deeply institutionalized in China by the time of his death.[7] Yet the complexities inherent in this project never abated and became

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China's Modernity (Chicago: University of Chicago Press, 2014); Kim Taylor, *Chinese Medicine in Early Communist China, 1945–63: A Medicine of Revolution* (London: Routledge, 2005); and Volker Scheid, *Currents of Tradition in Chinese Medicine, 1626–2006* (Seattle: Eastland Press, 2007).

[7] For an overview of Chinese medical policies in this period see Taylor, *Chinese Medicine in Early Communist China* (n. 6); Bridie Andrews, *The Making of Modern Chinese Medicine, 1850–1960* (Honolulu: University of Hawaii Press, 2014); Liz P. Y. Chee, *Mao's Bestiary, Medicinal Animals and Modern China* (Durham, N.C.: Duke University Press, 2021); and Volker Scheid, *Chinese Medicine in Contemporary China* (Durham, N.C.: Duke University Press, 2002), chap. 3.

particularly dense during the Cultural Revolution, which targeted "old ideas, old culture, old habits, and old customs." At the same time, the politics of the period turned a section of China's modern medical research infrastructure toward seriously investigating not just herbs but classical recipes and folk medicines, sometimes producing new substances, new names, and new applications in the process. The interpretive possibilities of how to assign credit to the Chinese or Western medical lineage in any particular instance thus remained broad, and arguably have grown more complex over time, despite "integrative medicine" seeking a perfect synthesis. Storytelling of all types requires selectively remembering and forgetting, while assigning emphasis or meaning to each step. So too, in the case of Chinese medicinals, assigning or withholding traditionality to substances that have made a seeming transition from that realm to global clinical use is a decision that is often renegotiated at various points along a drug's trajectory, and depends on the teller, the audience, and sometimes genuine (or deliberate) misinterpretation. The story of Chinese anti-cancer drug development and its attempt to balance modernity with tradition provides examples across all these choices.

We follow Chinese oncology's turn to indigenous materia medica mainly through published Chinese scientific papers from the Mao and early post-Mao periods (in the latter case, often reporting research that had begun during the Cultural Revolution) as well as reports by foreign scientists on fact-finding missions in the period of China's "opening" beginning in the early 1970s.[8] Scientific papers are rarely explicit about the context of their

[8] Our core database of Chinese sources includes 128 articles published in Chinese medical and pharmacological research journals between 1955 and 1979 that discuss Chinese materia medica as

production. And yet information about the ideological and practical circumstances in which research was conducted can often be pulled from their descriptions of procedures and materials, citation lists, and critiques of other projects, not to mention how they discuss CM, materia medica, and sometimes even political ideology as resource or inspiration. As such, the scientific and medical journals of this period constitute in themselves a form of infrastructure—a rich but overlooked resource for understanding Chinese medical history in this era, and particularly how China's drug discovery research balanced political imperatives with lab processes, protocols, and research goals.

Published research on anti-cancer drugs in this period not only emerged from the relatively well-apportioned laboratories of institutes and universities but extended to the small labs of research groups in hospitals and clinics. From the mid-1950s the state established many CM hospitals alongside those dedicated to Western medicine, and many of the latter eventually added CM departments. Most attempts to use Chinese materia medica to cure cancer in this period would initially emerge from such places, though by the Cultural Revolution "integrated" teams of CM and biomedical practitioners would prove an even

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having anti-cancer properties. These include 46 articles from the *Journal of Chinese Medicine* (中医杂志), 22 from the *Shanghai Journal of Chinese Medicine* (上海中医药杂志), 14 from the *Journal of the Pharmaceutical Industry* (医药工业), 12 from the *Chinese Herbal Medicine Newsletter* (中草药通讯), 9 from *Acta Pharmaceutica Sinica* (药学学报), 7 from the *Chinese Journal of Internal Medicine* (中华内科杂志), 5 from the *China Medical Journal* (English edition), 3 from *Medical Research Letters* (医学研究通讯), and 10 from provincial journals. These were located mainly through a title search for "cancer," "tumor," "carcinoma" or "leukemia." Publication of all these journals stopped in or before 1966 and resumed at various dates in the 1970s, excepting two that were founded in 1970. This cache is doubtlessly not comprehensive but is large enough to capture dominant approaches and discourses across this whole period.

stronger origin point. Drug research in such settings usually began with human patients, which was standard in CM practice, but the reverse of the biomedical protocol of beginning with pharmacological and animal studies before moving to clinical trials with humans.[9] As such, clinic-based CM research was often overlooked in later discussions of anti-cancer pharmacology, especially after international drug research protocols were formalized in China in the 1980s and 1990s.[10] All research methodologies and protocols are given equal consideration here, however, given the fluidity of what "drug research" meant throughout this turbulent period.

Chinese Medicine, Anti-Cancer Drugs, and the Great Leap Forward

Cancer was not among the first public health priorities for the early Communist state, which for most of the period we're considering was more concerned with eradicating infectious and parasitic diseases.[11] In 1956, however, a twelve-year plan was developed for cancer research, and by the beginning of the Great Leap Forward in 1958 there were twenty-four research

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[9] For a nuanced discussion of Chinese research protocols in drug testing, see Lei, *Neither Donkey nor Horse* (n. 6), 209–21. His examples are drawn from the Republican period, but the issues carried through to the early communist era.

[10] Such acts of omission manifested as early as 1973, when a treatise on Chinese anti-cancer drug research, compiled for the U.S. NIH, purposely omitted discussion of research by CM physicians, despite the inclusion of their articles in its bibliography. The author's given reason was lack of clinical trial evidence, though such accounts were exclusively based on human trials, albeit limited ones. Chen-Pien Li, *Anti-Cancer Agents Recently Developed in the People's Republic of China* (Washington, D.C.: NIH, 1973).

[11] George R. Pettit, "A View of Cancer Treatment in the People's Republic of China," *China Quart.* 68 (1976): 789–96.

units working on some aspect of oncology, though primarily related to epidemiology rather than drug development.[12] The vast majority of these researchers had backgrounds in and were using the methodologies and practices of "Western medicine," as biomedicine was then commonly described in China. The first National Cancer Symposium took place in 1959, and in 1962 Chinese researchers presented thirty-three papers at the Eighth International Cancer Conference in Moscow.[13] By this time China had broken diplomatic relations with the Soviet Union and had sent its Soviet advisors home, but competition between the Communist and capitalist blocs in the realm of cancer research had been ongoing since the late 1940s and might well have contributed to early Chinese interest.[14] Western medicine's failure to find a "magic bullet" to cure cancer seemed to have created an even playing field, while the rise of chemotherapy as a promising new direction in cancer therapy made anti-cancer drug discovery a growth field internationally.

Prior to the Great Leap Forward, however, there was relatively little interest in oncology from CM physician-researchers, to judge from the paucity of cancer-related articles in their otherwise fulsome journals. A survey of the two primary CM research organs, the *Journal of*

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[12] Li, *Anti-Cancer Agents* (n. 10), 1. For the history of Chinese research on the epidemiology of cancer in the early Communist period, see Lijing Jiang, "Global Epidemiology: Local Message: Sino-American Collaboration on Cancer Research, 1969–1990," in *Global Transformations in the Life Sciences, 1945–1980*, ed. Patrick Manning and Mat Savelli (Pittsburgh: University of Pittsburgh Press, 2018).

[13] Li, *Anti-Cancer Agents* (n. 10), 2.

[14] For cancer and the Cold War, see Nikolai Krementsov, "The KR Affair: Soviet Science on the Threshold of the Cold War," *Hist. Philos. Life Sci.* 17 (1995): 419–46; and Krementsov, "In the Shadow of the Bomb: US-Soviet Biomedical Relations in the Early Cold War, 1944–48," *J. Cold War Stud.* 9, no. 4 (Fall 2007): 41–67.

Chinese Medicine and *Shanghai Journal of Chinese Medicine*, from 1955 to 1957 finds only two articles dealing with cancer, compared to many dozens on maladies with better prognoses, such as Japanese encephalitis, asthma, ulcers, and others.[15] With the launch of the Great Leap Forward in 1958, however, the number of cancer-related articles across the two journals jumped to eight, and a total of twenty-four would be published prior to their shutdown in 1966, on the eve of the Cultural Revolution. This still contrasts with eighty-five cancer-related articles in the same period in a single biomedically oriented journal, the *Chinese Journal of Internal Medicine*, only three of which featured experiments with Chinese materia medica. Despite the official policy of integrating the two medicines, it's clear that in anti-cancer research at least, CM and Western medicine initiatives remained largely separate, with the latter taking the front seat.

Early forays into oncology by CM researchers often struck a note of caution, if not hesitation. One report from the Eleventh People's Hospital in Shanghai, for example, revealed that while a Special Cancer Group had been experimenting with the use of CM drugs for three years and had "achieved some experience of cancer treatment," the results were "immature and can only be used as a clue."[16] Cancer itself was treated in many reports as a new and problematic object for CM. Although "tumors" and their treatment were well recognized in classical medical texts, these could refer to both cancerous and noncancerous

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[15] Author's survey. Each journal published 125–150 articles per year, or a total between them of 750–900 articles in this three-year period.

[16] Pang Panchi, Liu Heyi, and Zhang Bone, "中医中药治疗癌症的线索" [Clues of Traditional Chinese Medicine in Treating Cancer], *Shang. J. Chin. Med.* 11 (1958): 13.

kinds, and provided no guidance for cancerous tissue that did not present in that form. Thus did some authors preface their discussions with caveats such as "cervical cancer is not recorded in classical literature,"[17] and "Chinese medicine does not have a specific term for leukemia."[18] Some attempted to create one-to-one correspondence between classical Chinese and Western nosology by, for example, claiming esophageal cancer was identical with the classical condition called *yege*.[19] This dilemma of correspondence would be overcome in most cases by reference to "pattern differentiation"—identifying and treating patterns of symptoms that accorded with those in classical literature, regardless of how Western medicine defined the disease.[20] But a significant minority of researchers would look to cure the disease itself by using materia medica as a direct and targeted therapy in the manner of Western medicine.

This initial caution of CM physician-researchers as they waded into oncology was also likely influenced by the common sense that cancer was usually a death sentence. This was true even with surgery and radiotherapy, then the two normative medical treatments in China, as elsewhere. As one article pointed out, "In the long-term treatment processes in the past . . .

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[17] Dezhou City Hospital of Chinese Medicine, "治疗子宫颈癌的点滴经验介绍" [Introduction to the Experience of Treating Cervical Cancer], *J. Chin. Med.* (1958), no. 10: 748.

[18] P. W. Chin, "中医治疗白血病的初步体会" [Traditional Medicine in the Treatment of Leukemia], *Chin. J. Internal Med.* (1960).

[19] P. C. Pang and I. C. Lei, "中医药治疗食道癌 1 例报导" [A Case Report on the Treatment of Esophagus Carcinoma with Chinese Medicine], *J. Shang. Chin. Med.* (1965), no. 9: 19–20.

[20] On pattern differentiation and its new application in the 1950s, see Scheid, *Chinese Medicine in Contemporary China* (n. 7), chap. 7. For its origin in the Republican period, see Lei, *Neither Donkey nor Horse* (n. 6), chap. 8.

(CM doctors) felt helpless and the medicine had no effect, so the patient was left without treatment for a long time and was waiting to die."[21] A Chengdu CM physician admitted that "in severe cases [of cancer], there is quite the idea of 'retreating when faced with difficulties,'" but since the Communist Party had made cancer a priority, he determined that "I should do my best."[22] These attitudes stand in contrast to CM research on more common maladies with somewhat better prognoses, which were confidently reported under titles such as "We Basically Cured Hypertension"[23] and "Chinese Medicine Has Conquered the Fortress of Cirrhosis."[24]

CM research on anti-cancer formulas was also hampered by the small number of case studies that could be gathered at any one clinic or hospital. Reports of successful or promising CM cancer cures generally presented no more than two to six cases, and often only one. By contrast, articles about more common and less lethal conditions often drew on experience with dozens if not hundreds of cases. This suggests either the rareness with which

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[21] Dezhou City Hospital, "Introduction to the Experience of Treating Cervical Cancer" (n. 17), 748.

[22] Zhang Chengan, "对于癌瘤治疗的体会" [Experience on Cancer Treatment], *J. Chin. Med.* (1958), no. 11: 744–45.

[23] Wang J. M., "我们基本上征服了高血压" [We Basically Cured Hypertension], *J. Chin. Med.* (1958), no. 10: 668–69.

[24] Hebei Province Traditional Chinese Medicine Research Institute Preparatory Office, "中医中药攻下了肝硬变的堡垒" [Chinese Medicine Has Conquered the Fortress of Cirrhosis], *J. Chin. Med.* (1958), no. 10: 660–63. The exception is an article in the same issue telling the story of a young biomedically trained doctor curing over a hundred cancer patients with a pill made from toxic minerals, and against opposition from his colleagues. This reads like a piece of party propaganda, however, and was unlikely to have been written by physicians. Deng L. S. and Zhang Z. Y., "祖国医学攻克'不治之症'——青年医士徐志用神农丸治癌瘤有显著疗效" [Medicine of the Motherland Overcomes "Incurable Diseases"—Young Physician Xu Zhi Uses Shennong Pills to Treat Cancer Tumors with Remarkable Therapeutic Effects], *J. Chin. Med.* (1958), no. 10: 718–67.

cancer patients approached CM hospitals and clinics as opposed to those offering surgery and radiation therapy, or the perceived difficulty of achieving successful outcomes with herbal formulas. Some published cases involved patients who had first been advised to seek surgery but turned to CM because they feared the operating table. In other instances the case pool was built from those whose surgery or radiotherapy treatment had been unsuccessful, or who had relapsed after a period of better health.[25] Such reports anticipate what would later become a common trope of CM as a "treatment of last resort," leading to a possible "miracle cure."[26] Few articles in this early period strike an overtly triumphalist note, but reports of patients unable to be cured by Western medicine and saved from certain death by CM clearly constituted a critique, and an argument for continuing and deepening research into Chinese materia medica.

The anti-cancer therapies described in CM articles of this period follow a number of different patterns or strategies. The most common are attempts to use existing prescriptions of herbs and animal tissue, adjusted to a patient's condition according to common diagnostic procedures and informed by classical theories. But a significant minority of articles break from classical medicine to explore "magic bullet" approaches involving single herbs or novel combinations. Thus one article presented the inhalation of honeysuckle powder as a cure for

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[25] Pang Panchi et al., "Clues of Traditional Chinese Medicine" (n. 16). Of the three cases discussed in the article, one had seemingly been cured by radiation therapy but then relapsed, a second had relapsed after surgery, and the third was in too late a stage to be treated with biomedicine.

[26] For a discussion of this phenomenon in the contemporary period, see Mei Zhan, *Other-Worldly: Making Chinese Medicine through Transnational Frames* (Durham, N.C.: Duke University Press, 2009), chap. 3.

nose cancer,[27] while a research team at the Shanghai College of Chinese Medicine tried to cure tumors in mice using mountain bean root.[28] A third article leads with this testimony from one of the author's patients: "Everyone called [mammary cancer] a terrible disease. Seeking treatment from a certain Chinese medicine practitioner was ineffective, and self-administered moxibustion in the local area more than 50 times had no effect."[29] In desperation the patient had tried "two baked stems of old pumpkins," and after just a few doses, "the nodules gradually shrank away." Aged pumpkin stems were a classical medicine for preventing miscarriages, curing whooping cough, and treating wounds, but according to the physician-author of the report, "After examining the historical literature, there has not been any record of this product treating breast cancer or similar cases. But this treatment case is indeed a fact based on the experience of the people, so there must be principles to be found."[30] Reaching for innovation in the absence of classical direction and focusing on a single herb or animal tissue with seemingly newfound powers would become an increasingly common research design in the years ahead.

Other CM projects in this period seem to take their lead from chemotherapy, which although still experimental in China was a subject of significant research interest in the

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[27] Nan-An Hospital, "金银花粉治愈鼻腔腺癌一例" [Treatment of Nasal Cavity Carcinoma with Pollen of Gold-Silver Flower], *Fukien Chin. Med*. (1959), no. 6: 266.

[28] Z. S. Da and P. D. Zheng, "山豆根的抗癌效果" [Anti-cancer Effects of Mountain Bean Root], *J. Chin. Med.* (1961), no. 6: 25–26.

[29] C. C. Lee, "陈南瓜蒂治癒初期"乳房癌"二例报告" [A Report of Old Pumpkin Stalk in the Treatment of Primary Mammary Carcinoma], *J. Chin. Med.* (1958), no. 12: 818.

[30] Ibid.

country's leading biomedical journals. In chemotherapy, "cocktails" of generally toxic drugs are administered to kill cancer cells. CM physician-researchers in this period almost never frame their own prescriptions in terms of chemotherapy, but the classical adage "fighting poison with poison" encouraged some to combine toxic materia medica in novel anti-cancer concoctions that roughly paralleled chemotherapeutic approaches.[31] Thus the Cancer Clinical Research Group at the Taiyuan Institute of Chinese Medicine experimented on sixty-four cervical and esophageal patients with a formula consisting of toads, white snakes, gold-headed centipedes, whole scorpions, and "a hornet's nest from the mountains with larvae."[32] What's notable in this formula is the almost total concentration on toxic elements, and the absence of herbs to lessen or balance its presumed effects, as was standard in most other published prescriptions.

Despite the impetus of the Great Leap Forward, this first phase of integrating Chinese materia medica with oncology saw no agreed-upon breakthroughs in anti-cancer therapies. Few research articles in this period referenced earlier ones, and few promising formulas reported in one article were taken up and tested in another. The most sustained research effort

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[31] Even more normative polyherbal prescriptions in articles of this period generally include at least one animal tissue or mineral as an ingredient, sometimes with the explicit purpose of increasing toxicity. For example, one article describes augmenting the potency of an anti-cancer formula this way: "[Two whole] centipedes were added to the prescription due to their toxic nature and rapid mobility, following the principle of using poison to combat poison." C. C. Chen, "鳞状上皮癌一例治验" [Treatment of a Case of Squamous Epithelium Carcinoma], *J. Chin. Med.* (1966), no. 4: 9.

[32] C. D. Chiang, "中医药治疗食道癌、宫颈癌的初步报导" [A Preliminary Report on Chinese Medicine in the Treatment of Esophagus Carcinoma and Cervix Carcinoma], *J. Shang. Chin. Med.* (1965), no. 10: 16–20.

was that made by the Institute of Materia Medica (IMM) of the Chinese Academy of Sciences, which had a long history of screening Chinese herbs for active ingredients of all types using mouse models. In the period 1958 to 1962, its pharmacology department screened 311 herbs and forty-seven recipes "commonly used in CM to treat neoplasms or tumorous diseases, or from herbs that belong to the genus of the same species." It reported in 1963, however, that only three (0.8 percent of those tested) had "definite anti-tumor effects," and expressed criticism of the loose protocols and methodologies tolerated by CM research groups, from whom most of its leads had been sourced.[33] By this time the Great Leap Forward had ended, and with it any hesitation the pharmacologists at the IMM might have felt at dampening faith that CM would so easily yield anti-cancer therapies.

A similar pessimism was expressed by some members of the CM research community itself. In 1966 a famous associate of Chairman Mao, Jiao Yulu, was proclaimed a "Revolutionary Martyr" after having died of liver cancer two years earlier. One CM cancer research group declared "we bear an inescapable responsibility for the death of Comrade Jiao Yulu," lamenting "Comrade Jiao Yulu died actively applied Chairman Mao's writings, overcoming the three harms of flooding, sandstorms, and salinity for the masses. Yet we were unable to conquer liver cancer . . . Although we have initially explored some methods of treating liver cancer, we have not yet discovered universally effective rules . . . these methods

[33] H. P. Lei, "关子抗肿瘤药物的研究 Ⅱ.358 种植物药、中药单方及复方对动物移植性肿瘤的影响" [Studies on Antitumor Drugs II. The Effect of 358 Herbal Drugs, and Single and Composite TCM Recipes on Transplanted Tumors in Animals], *Acta Pharma. Sinica* (1963), no 4: 199–214.

are only effective for certain individuals."[34] The admission is significant because it came from Pang Panchi, whose research group was among the first to take up anti-cancer drug discovery using materia medica more than a decade earlier and would publish the greatest number of articles (five) on the topic in the interim. Pang, a rare female practitioner of Chinese medicine from a respected family of such physicians, would go on to a long and celebrated career in oncology. But she would not publish another research article on cancer until 1982. And by that time her approach had changed from trying to cure cancer with materia medica alone to using CM with the framework of "integrated medicine."[35] This shift would be one of many conflicting legacies of the Cultural Revolution.

The Cultural Revolution and "Integrated" Anti-Cancer Drug Research

The early Cultural Revolution temporarily stopped the publication of scientific and medical journals in China. When publication resumed in the early to mid-1970s, their tone had significantly changed, the authors having lived through a period of revolutionary fervor that saw the denunciation of the Health Ministry and the sending down of urban doctors and nurses to the countryside to learn from the peasantry. Folk remedies had been ideologically lifted above the classical practice of Chinese medicine, and doctors and researchers trained in biomedicine were now much more willing to "cross over" and experiment with all manner of

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[34] P. C. Pang and I. C. Lei, "中医药治疗四例肝癌的体会" [Treatment of Four Cases of Liver Cancer with Chinese Traditional Medicine], *J. Chin. Med.* (1966), no. 5: 33–37.

[35] Pang would live (and practice) long enough to be interviewed by anthropologist Mei Zhan when in her eighties. Zhan, *Other-Worldly* (n. 26), 108–9, 157–59.

materia medica.[36] Whereas anti-cancer drug initiatives by CM and Western medicine researchers in the period 1955 to 1966 had been largely segregated, the 1970s saw a growing number of projects described as "integrated." Integration had long been the party line, but was now treated more earnestly by oncology researchers from both ends of the spectrum.

There was also a new realization in the China of this period that cancer was a growing source of mortality, as infectious and parasitic diseases were increasingly brought under control. Cancer had become the leading cause of death in Shanghai by 1973,[37] and the death rate in Beijing from lung cancer (which had the highest mortality rate among malignant tumors in that city) more than doubled between 1958 and 1973.[38] Moreover, cancer was now recognized as not just an urban disease but responsible for pockets of high mortality in rural China as well. This was well demonstrated by a nationwide study of the disease's epidemiology, launched in the early 1970s, which would become a global model.[39] Fighting cancer was thus now perfectly convergent with Mao's advice to "place the emphasis on the countryside," an alignment that would have been more difficult to defend in the Great Leap Forward period. Cancer was even beginning to affect the Chinese leadership. Premier Zhou Enlai was diagnosed with bladder cancer in 1972 and died from the disease in 1976.

An agenda for a new war on cancer was set as early as 1969, when a National Cancer Work Conference called for eradication of the disease within just three years. This was

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[36] For the turn to folk medicine, see Chee, *Mao's Bestiary* (n. 7), esp. chap. 4.
[37] John R. Quinn, ed., *China Medicine as We Saw It* (Washington, D.C.: National Institute of Health, 1974), 121.
[38] *Ch. J. Internal Med.* 1 (1978).
[39] See Jiang, "Global Epidemiology" (n. 12).

described in one publication as "the battle call of the proletarian headquarters to research and develop radical cures for tumors,"[40] and was accompanied by rhetoric such as "fight a people's war for the radical cure of cancer" and "in the battle against tumors, we should preserve ourselves and destroy the enemy."[41] Over the next few years an Oncology Drug Research Experience Exchange Meeting took place annually in Shanghai, where doctors (both from CM and biomedical backgrounds), lab researchers, and pharmaceutical factory workers from across the country came together to denounce the previous war on cancer as bourgeois, and hence unsuccessful, and to mobilize the masses for a broader-based assault.[42] "The direction of cancer work has been reversed" declared the report of the first meeting, "it is now oriented to the rural areas, the grassroots, and the masses."[43]

One element in this reversal was canvassing "the masses" for potential cancer cures. The same team undertook a "prescription donation campaign" and collected over a hundred "anti-cancer recipes" and samples of more than eighty kinds of ointments, pills and powders.[44] Mixed teams of doctors, scientists, and workers, like one in Guangdong, "went deep into mountainous areas, rural areas, and cancer wards to conduct research and excavate the

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[40] Shanghai Pharmaceutical Industry Company Revolutionary Committee Product Group, "高举毛泽东思想伟大红旗 肿瘤药物科研经验交流会报道" [Report on the Cancer Drug Research Experience Exchange Meeting, Hold High the Great Red Flag of Mao Zedong Thought], *J. Pharma. Industry.* (1971), no. 2: 5–8, quotation on 5.

[41] Ibid., 5.

[42] Ibid.; Editors, "全国抗癌药物经验交流学习班报道" [Report on the National Anti-Cancer Drug Experience Exchange Study Class], *J. Pharma. Industry* (1972), no. 7: 41–43.

[43] Shanghai Pharmaceutical Industry, "Report on the Cancer Drug Research Experience" (n. 40), 7.

[44] Ibid., 6.

motherland's medical heritage."[45] Urban institutions like the Peking Cancer Hospital likewise dispatched teams to the countryside in search of folk prescriptions.[46] Some groups seem to have been proselytizing for specific therapies as much as collecting information about them. Thus did a "special investigative team" of Hangzhou physicians and pharmaceutical factory workers visit at least ten area hospitals and seven communes to "gain insight into the use of vine pear roots to treat certain cancers."[47]

Reducing the costs of cancer therapies is never explicitly mentioned in these articles as a goal. Yet the concentration on herbs common to a particular area, and thus virtually free, corresponds to the more general emphasis in this period, especially before 1969, on self-sufficiency and maintaining a wartime footing. On the other hand, the prominent participation of pharmaceutical factory personnel on such teams meant there was also an emphasis on turning raw materials into marketable drugs, often in pill or tablet form. This would help set the stage for what would become local or specialty CM drug industries in the post-Mao period.

Testimony as to the peasant origins of a new therapy often contributed to its charisma as research object. For example, a 1972 report on the anti-cancer properties of the grasslike herb *nongjili* (*Crotalaria sessiliflora*) by the Shandong Institute of Chinese Medicine traced its

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[45] Ibid., 5–6.

[46] Pettit, "View of Cancer Treatment" (n. 11), 791.

[47] Hangzhou Pharmaceutical Factory et al. "草药藤梨根治疗癌症情况的调查" [Investigating the Treatment of Cancer with the Herbal Medicine Vine Pear Root], *Chin. Herb. Med. Newsl.* (1970), no. 1: 18–19, quotation on 18. The "vine pear root" in question was *Actinidia arguta*, or the hardy kiwi. The article states it had been used to "treat cancer beginning in the second half of 1965" around Zhejiang province.

history to an old, poor farmer who had been diagnosed with squamous epithelial cancer in 1963. "The academic authority of the bourgeoisie" as the report called the farmer's biomedically-trained physicians, "declared it an incurable disease and urged patients to have their limbs amputated." The farmer "flatly refused" and then "recalled that 30 years ago, some people used nongjili . . . to treat malignant sores." He thus pulled up some of the grass, pounded it into a paste, and successfully used it to cure himself. "The fact that a handful of grass cured cancer" concluded the article, "is a complete death sentence for what the bourgeois authority calls an incurable disease." Interest in the herb soon "spread from Shandong to Beijing and Shanghai" and the IMM and other labs began searching for its active ingredient.[48] This paralleled the process that would lead to the creation of Drug 713 in Harbin in the same period, although that case was initially reported only in provincial journals and would not come to the attention of medical researchers in Shanghai and abroad for another two decades.[49]

The new enthusiasm for finding anti-cancer properties in materia medica extended to China's top research institutes, such as the IMM, which as we have seen had been skeptical about that project following the Great Leap Forward.[50] During the Cultural Revolution,

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[48] Shandong Dezhou Regional Cancer Research Group, "应用农吉利治疗恶性肿瘤 115 例疗效观察" [Observation of the Therapeutic Effect of 115 Cases of Malignant Tumors Treated with Nongjili], *Chin. Herb. Med. Newsl.* (1972), no. 2: 4–7, quotations on 4; Shandong Institute of Chinese Medicine et al., "农吉利治癌的研究" [Research on Nongjili Cancer Treatment], *J. Pharma. Industry* (1973), no. 3: 10–13; Editors, "Report on the National Anti-Cancer Drug Experience" (n. 42).

[49] Rao et al., "A Drug from Poison, 499–500 (n. 2).

[50] See note 36.

however, both the IMM and the Shanghai Institute of Materia Medica (SIMM) expanded and accelerated the screening of potential anti-cancer herbs and expressed greater optimism about their prospects. The SIMM reported that "the number of samples screened in Shanghai alone every year is in the thousands," which it ascribed to anti-cancer drug research having become "a mass movement," with a "vast number of workers, peasants, and soldiers [having] joined the anti-cancer front."[51] It admitted in the same breath, however, that the vast majority of leads ended up being screened out as ineffective. The institute was also concerned over expressed skepticism toward its reliance on the use of animal (primarily mouse) models, which "some" (presumably CM physician-researchers) "have an entirely negative attitude towards," believing that they allowed "too many opportunities for effective drugs to slip through the screen."[52] Still, an IMM article of 1979, looking back on the previous decade of screening by it and other labs, positively cited sixty-three scientific articles reporting anti-cancer effects in dozens of herbs. Only three of these citations were from the period prior to the Cultural Revolution.[53] In that sense the report agreed with the 1963 finding that the first decade of drug discovery had been mostly barren and credited the Great Proletarian Cultural Revolution with effecting the change.

Even more so than during the Great Leap Forward, however, the new dynamic driving

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[51] Shanghai IMM Cancer Research Group, "抗癌药物筛选方法的研究近况" [Recent Research on Anti-Cancer Drug Screening Methods], *J. Pharma. Industry* (1972), no. 7: 45–54, quotation on 45.
[52] Ibid., 46.
[53] Implantation Laboratory, IMM, "我国三十年来中草药研究概况" [Overview of Research on Chinese Herbal Medicine in My Country over the Past 30 Years], *Acta Parma. Sinica* (1979), no. 12: 746–68.

drug discovery in materia medica occurred within a frame set by chemotherapy, which had further developed globally since the early 1960s. "Integrated medicine" in many cases meant using Chinese materia medica to lessen the toxic effects of chemotherapeutic cocktails and/or increase the survivability of patients by boosting their immune systems. This was called "health helping" (*Fu-zheng* or FZ) therapy in Chinese. Beginning in 1974, FZ was the subject of a study involving 572 patients with different types of cancer in seven hospitals. A retrospective report on this project described it as using CM "as an adjuvant to other modalities, and in supportive care."[54] Such projects brought CM and Western medicine doctors together, but with biomedically sourced chemotherapy drugs constituting the core therapy.

At the same time, the ongoing search for anti-cancer agents within Chinese materia medica took on a more systematic structure, with the ultimate goal being to find an "active ingredient" (i.e., molecule) that could be synthesized into a biomedical drug. A signature result of this effort was Indirubin, refined from the herb *Indigofera tinctoria*, an element in the classical Chinese pharmacy. From 1966 through 1974, an "integrated research team" at the Institute of Hematology in Chengdu experimented with treating leukemia with materia medica. "Under the idea of fighting poison with poison" it reported "a variety of insect-based and mineral medicines were [initially] used," but most were subsequently rejected as too

[54] Yan Sun and Jing-Yu-Huang, "The Role of Traditional Chinese Medicine in Clinical Oncology," in *Recent Advances in Cancer Research and Therapy*, ed. Xin-Yuan Liu et al. (Burlington, Vt.: Elsevier, 2012), 409–10, quotation on 425.

toxic.[55] The team spent the next eight years experimenting with different combinations of the ingredients in *Dang Gui Lu Hui*, a classical prescription with ten herbs and one animal component (musk), and testing each formulation on patients through clinical trials. Nine ingredients were eventually set aside as "not affect[ing] the efficacy" of the compound, and musk was abandoned because of its expense, leaving the research team with a single potentially active ingredient in the herb *Indigofera tinctoria.*[56] An extract from that plant was then further reduced to its constituent chemical parts, one of which, accounting for only 0.11 percent of the sample, was isolated as the active molecule, and named Indirubin. Even *Indigofera tinctoria* was abandoned once the active molecule had been found, however, as a larger yield of Indirubin could be had from the related plant *Indigo naturalis*.[57]

Indirubin would subsequently be celebrated in China as a major breakthrough drug and became the subject of research that extends to the present day. As narrated in a retrospective scientific article of 1988, the scientists in Chengdu had "discovered the efficacy of a famous Chinese prescription, *Dang Gui Lu Hui*" through their isolation of the Indirubin molecule.[58] As with Drug 713, however, the laboratory process that created Indirubin arguably ended up

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[55] Department of Hematology Affiliated Hospital of Chinese Academy of Medical Sciences, and Department of Internal Medicine, Affiliated Hospital of Chengdu College of Traditional Chinese Medicine, "当归芦荟丸治疗慢性粒细胞型白血病的临床研究" [Clinical Research on the Treatment of Chronic Myelogenous Leukemia Using Angelica Sinensis, Aloe Vera Pills], *Chin. J. Internal Med.* (1976), no. 2: 15, 86–88.

[56] Jui Han, "Traditional Chinese Medicine and the Search for New Antineoplastic Drugs," *J. Ethnopharma.* 24, no. 1 (1988): 1–17, quotation on 3; see also Rui Han, "Highlight on the Studies of Anticancer Drugs Derived from Plants in China," *Stem Cells* 12, no. 1 (1994): 53–63.

[57] Jui Han, "Traditional Chinese Medicine" (n. 56).

[58] Ibid., 3.

questioning the efficacy of the traditional prescription far more than demonstrating it, as ten of the ingredients were rejected as "inactive" and the one remaining herb was further reduced to a single molecule.

As with the use of mouse models, the process of locating active molecules to prove the efficacy of Chinese herbs was controversial among CM physician-researchers. A 1971 editorial in the *Chinese Herbal Medicine Newsletter* put it this way: "Some bourgeois die-hards stood up and challenged 'You say Chinese medicine is good, please come up with the molecular formula.' The discovery of the fractural formula is an achievement, but the molecular formula is by no means the only criteria of testing science . . . Successful experiences of using Chinese medicine to cure diseases are beaten to death with the word 'unscientific.'"[59] Like most CM physician-researchers of this period, however, the author was not willing to cede "science" to biomedicine, nor to entirely reject the project of identifying active ingredients through lab analysis, as would some later conservatives. "Of course we will never refuse to study the molecular formula of Chinese medicine . . . [but] through the practices of the broad revolutionary masses . . . we will definitely be able to find scientific explanations . . . and we will definitely be able to come up with molecular formulas."[60] His goal, echoing that of the Party, was the creation of a "unified new pharmacy." The logic of that position, however, was that Chinese materia medica be

[59] Editors, "坚持中西医结合的正确方针" [Adhere to the Correct Policy of Integrating Chinese and Western Medicine], *Chin. Herbal Med. Newsl.* (1971), no. 1: 2–3.
[60] Ibid, 3.

subjected to biomedical lab protocols with uncertain outcomes for prior claims of efficacy.

CM cannot be excised from the stories of Indirubin, Drug 173, and other "new drugs," however, as neatly as CM theories and "inactive" ingredients were in the lab. In these and other cases the discovery process began with a politically-correct turn to the analysis of classical or folk compounds. Had that turn not been made, few of these drugs would likely have been discovered independently through broad-spectrum prospecting. We can say that CM guided each research team to the eventual molecular discovery, however indirectly, although along the way many more Chinese medicinals were tagged as inactive or toxic and polyherbal recipes (the locus of knowledge and practice of Chinese medicine doctors) were cast aside almost completely.

Chemotherapy and Bioprospecting

Despite their unique political circumstances, Chinese efforts by the Cultural Revolution period must also be seen within the context of an expansive global research investment in cancer chemotherapy, and a resulting growth in bioprospecting for so-called botanicals (drugs derived from plants and trees). The term "bioprospecting" normally evokes images of Western pharmaceutical companies scouring remote corners of the natural world for drug sources with commercial potential. But in the case of early Communist China, it was the corpus of indigenous materia medica—classical and folk—that was the starting point for anti-cancer drug discovery. In this sense ethnopharmacology and bioprospecting in China overlapped, as was recognized by Pui-Yan Kwok, a University of Chicago researcher who

went to study integrated medicine in China around 1980: "Although the discoveries are guided by information contained in ancient medical classics, the whole experimental process is the same as what modern chemists and pharmacologists would have taken . . . this is not unlike collecting plants from the Amazon rain forest . . . traditional knowledge is utilized and absorbed into modern science without real integration."[61] This passage evokes the idea of a "reformulation regime" as Pordie and Gaudilliere have described it,[62] or the "re-working" of medicinals from CM to biomedicine as discussed by Lei.[63] This may be an accurate picture of how anti-cancer drug research had evolved by the Cultural Revolution period and after, but it nonetheless leaves aside, as we shall see, the power of CM to absorb new drugs into the lineage of the Chinese pharmacy even as their physical connection to materia medica, and to CM theory, became increasingly attenuated.

By the late 1950s, the promising results of chemotherapy in the West meant that cancer research would henceforth lead the field of drug discovery on a global basis. By the 1960s this was spurring a search for more anti-cancer agents that could potentially contribute to multidrug therapies or that might be effective against at least one of the many types of cancer. Most anti-cancer drugs were still synthesized from inorganic or bacterial sources, but botanicals were of increasing interest to anti-cancer research efforts in the capitalist world

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[61] Pui-Yan Kwok, "Integration of Traditional Chinese Medicine and Western Medicine in Contemporary China" (Master's thesis, University of Chicago, 1981), 28–29.

[62] Laurent Pordie and Jean-Paul Gaudilliere, "Reformulation Regimes in Drug Discovery: Revisiting Polyherbals and Property Rights in the Ayurvedic Industry," *East Asian Sci. Technol. Soc.* 8, no. 1 (2014): 57–80.

[63] Lei, *Neither Donkey nor Horse* (n. 6), 218–19.

during the same period. This was spurred by the Canadian-American development in the early 1960s of the chemotherapy drug Vincristine (representing the first letter in the famous multidrug cocktail VAMP) from the Madagascan periwinkle, which was inspired by the plant's use in folk medicine (though not to treat cancers) in Africa and the Caribbean.[64]

Sustained bioprospecting among plant species for active ingredients thus provided a point of convergence between Chinese and Western cancer research strategies. Western bioprospecting, however, as organized globally by the U.S. National Cancer Institute, and despite the initial example of periwinkle, was broad-gauged and not much guided by ethnobotany nor the prior use of a plant or tree in indigenous medicine. Chinese bioprospecting, by contrast, occurred almost exclusively within the pharmacopeia of herbs, minerals, and animal substances used and/or chronicled by Chinese medicine.[65] This included by some estimations up to ten thousand plants, or one out of three of the approximately thirty thousand plant species native to China. China has a more substantial botanical inheritance than either the United States or Europe, accounting for possibly 10 percent of plant species on Earth.[66] That still meant, however, that roughly two-thirds of plant species in China remained outside the bounds of Chinese analysis because they were

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[64] Peter Keating and Alberto Cambrosio, *Cancer on Trial: Oncology as a New Style of Practice* (Chicago: University of Chicago Press, 2011), 56–57.

[65] As one Chinese pharmacologist described the process, "Special efforts have been made to use the experience of folk medicine and TCM in the research and development of new antineoplastic drugs in China. In contrast to random screening, a rational approach guided by the experience of TCM is economical and can increase the probability of success." Jui Han, "Traditional Chinese Medicine and the Search for New Antineoplastic Drugs," *J. Ethnopharma.* 24, no. 1 (1988): 1–17, quotation on 3.

[66] Peter H. Raven, "Floras, Plant Conservation, and China's Future," in *Drug Discovery and Traditional Chinese Medicine*, ed. Yuan Lin (New York: Springer, 2001), 13–18.

not classed as materia medica.

The early 1970s was also coincident with China's "opening" to the Western world, and with it, greater contact with foreign pharmaceutical research, through both publications and the appearance of Western scientists and doctors in China on fact-finding missions. This facilitated greater knowledge exchange in the form of research collaborations and drug importation. The historian Fang Xiaoping has pointed out that price reductions brought a flood of biomedical pharmaceuticals into China as early as 1969, resulting in "even the most conservative Chinese doctors start[ing] to prescribe Western medicine in the 1970s."[67] Thus did the newly revived Chinese medical and pharmaceutical journals of the early 1970s begin featuring sections such as "foreign technology trends" and "overview of foreign new drugs," including many chemotherapy drugs then under development or trial in the United States and elsewhere.

Ironically, one of these chemotherapeutic drugs, and a key product of Western bioprospecting in this period, was a tree native to China, but outside what Mao had called the "treasure chest" of materia medica. Hydroxycamptothecin (HCPT, or colloquially Camptothecin) was an active ingredient distilled from native Chinese tree *Camptotheca acuminata* in the early 1960s. Examples of the tree had been shipped to America for their ornamental value in the early twentieth century and decades later became caught up in the broad-spectrum prospecting of the U.S. National Cancer Institute. Early findings of its

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[67] Xiaoping Fang, *Barefoot Doctors and Western Medicine in China* (Rochester, N.Y.: University of Rochester Press, 2012), 119, quotation on 104.

potential as an anti-cancer agent were published in the United States in 1966, just as China's own research culture was temporarily upended by the Cultural Revolution.[68] The tree had likely been neglected by PRC researchers because their own bioprospecting was guided almost exclusively by ethnopharmacology.

When Chinese drug discovery resumed in the later Cultural Revolution, however, published American research about Camptothecin was the catalyst for additional research at SIMM and elsewhere in China.[69] The drug went into trial production in Shanghai as early as 1969, and by 1970 had shown "good clinical results" in over one hundred cases in nine hospital units. The Chinese researchers were able to reduce its toxicity by using a different part of the plant and eventually adopted it even more successfully for clinical use.[70] An American delegation visiting the SIMM in the 1970s noted its use and assumed that Chinese interest in the drug had been spurred by its prior use in CM. But they were told in answer to their inquiries by Chinese researchers that the tree had no record of previous medicinal use in China.[71] Ethnobotanists would discover much later, in 2014, that a minority people in South China had indeed used the tree medicinally.[72] But this "folk medicine" knowledge had

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[68] Monroe Wall et al., "Plant Anti-Tumor Agents I: The Isolation and Structure of Camptothecin, a Novel Alkaloidal Leukemia and Tumor Inhibitor from *Camptotheca acuminata*," *J. Amer. Chem. Soc.* 88 (1966): 3888–90.

[69] Bin Xu et al., "Advances in Cancer Chemotherapeutic Drug Research in China," in Xin-Yuan Liu et al., *Recent Advances in Cancer Research and Therapy* (n. 54), 292.

[70] Ibid.

[71] National Research Council, *Oral Contraceptives and Steroid Chemistry in the People's Republic of China: A Trip Report of the American Steroid Chemistry and Biochemistry Delegation* (Washington, D.C.: National Academies Press, 1977), 63.

[72] Shiyou Li and Wanli Zhang, "Ethnobotany of *Camptotheca Decaisne*: New Discoveries of Old Medicinal Uses," *Pharmaceut. Crops* 5 (2014): 140–45; Rui Han, "Highlight on the Studies of

remained unknown to the SIMM researchers, and its indigenous use was in any case unrelated to cancer therapies.

The story of Camptothecin could have been told as exemplifying a productive dialogue, albeit carried on indirectly, between U.S. and Chinese cancer research labs despite the political divide of the Cold War.[73] But the politics of the period precluded such a storyline. Camptothecin would be hailed by China's biomedical and CM research communities alike as a breakthrough anti-cancer drug derived from Chinese materia medica. Exactly how this identity was drawn depended on the writer. Writings by SIMM and IMM pharmacologists were careful to trace the drug's lineage to Western labs, with whom they were now beginning to collaborate.[74] But a 1971 article by staff of the Shanghai No. 10 Pharmaceutical Factory presents the drug as from "a unique tree in our country," and one whose production would allow China "to catch up with and surpass . . . US imperialism." An article the following year by the "Shanghai Factory, Scientific Research, and Clinical Camptothecin Collaboration Group" described it as "a Chinese herbal medicine with strong anti-cancer effects," which had been "jointly developed by Chinese workers, scientists, and medical personnel."[75] In

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Anticancer Drugs" (n. 56), writes that "*C. acuminata* was used in folk medicine in Zhejiang Province for the topical treatment of psoriasis," but there is no evidence that this folk medical use was known about in Beijing and Shanghai in the 1970s.

[73] Bin Xu, "Advances in Cancer Chemotherapeutic" (n. 69) do present the drug's history this way, segregating their discussion of HCPT from a subsequent section of the article on "Some Meaningful Anti-Cancer Substances from Traditional Chinese Medicine."

[74] Cai Junchao et al., "抗肿瘤药喜树碱的国外研究概况" [Overseas Research Overview of Anti-Tumor Drug Camptothecin], *J. Pharma. Industry* (1973), no. 8: 34–48.

[75] Shanghai Nanchang Pharmaceutical Factory et al., "喜树碱研究简报" [Camptothecin Research Brief], *J. Pharma. Industry* (1971), no. 3: 23–27.

subsequent articles listing promising Chinese anti-cancer drugs, Camptothecin would invariably be listed first among others "that emerged during the mass movement" (i.e., the Cultural Revolution) along with nongjili and, later, Indirubin.[76] Such interpretations have stuck, so that most post-Mao period scientific papers and popular sources alike have placed Camptothecin, like Drug 713 and Artemisinin, in the category of modernized traditional Chinese medicine rather than a product of knowledge circulating between international labs using a tree native to China.[77] In such cases the drug has been re-networked from biomedicine into CM, the reverse of the process we saw with Drug 713.

An equally complicated case is the chemotherapy drug Harringtonine. This was isolated by the U.S. National Cancer Institute and Department of Agriculture in the 1960s from the shrub *Cephalotaxus harringtonii*, a species native to Japan (the common English name is Japanese plum yew). The Linnean classification references the Fourth Earl of Harrington, who was among the first Europeans to cultivate it as an ornamental plant, in the 1820s.[78] The plant had thus experienced a long period of international circulation by the time the U.S. Department of Agriculture began screening its seeds in the 1950s, in the search for new

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[76] Shanghai Factory, Scientific Research, and Clinical Camptothecin Collaboration Group, [Summary of Clinical Research on Camptothecin], *J. Pharma. Industry* (1972), no. 1: 1–6, quotations on 1, 6.

[77] Examples include Xiao Zheng et al., "Developments in Drug Delivery of Bioactive Alkaloids Derived from Traditional Chinese Medicine," *Drug Delivery* 25, no. 1 (2018): 398–416; Rui Han, "Highlight on the Studies of Anticancer Drugs" (n. 56); Yan Pi et al., "Examination of Camptothecin and 10-hydroxycamptothecin in *Camptotheca acuminata* Plant and Cell Culture, and the Affected Yields Under Several Cell Culture Treatments," *Biocell* 34, no. 3 (2010): 139–43; and Stringer S. Yang et al., "The Camptothecin Experience: From Chinese Medicinal Plants to Potent Anti-Cancer Drugs," in Yuan Lin, *Drug Discovery and Traditional Chinese Medicine* (n. 66), 61–74.

[78] "About: Cephalotaxus Harringtonii," https://dbpedia.org/page/Cephalotaxus_harringtonii (accessed October 16, 2022).

sources of vegetable oil. Their aqueous extracts were later shared with the National Cancer Institute, which isolated the active ingredient that became Harringtonine and reported it internationally as a promising anti-cancer agent in 1970.[79]

The Japanese plum yew is closely related to at least two species of the same plant native to China, the Chinese plum yew (*Cephalotaxus fortunei*) and Hainanese plum yew (*Cephalotaxus hainensis*). Thus, in 1972, the Guangdong Pharmaceutical Corporation cited "foreign reports" of the "significant anti-cancer effects" of drugs made from this genus of tree as its spur to the testing of native species.[80] A few months later a Fujian pharmaceutical factory was producing an "anti-cancer injection" from the bark of the Chinese plum yew,[81] and by 1976 researchers at both the IMM in Beijing and the SIMM were reporting promising clinical trials with Harringtonine. The initial paper written by staff of the SIMM credited the earlier American research but also stated that the plant *C. fortunei* "has long been used in tumor treatment in folk medicine."[82] Mention of either the original American research or the possible link to folk medicine was missing in the next two Chinese scientific papers discussing the drug.[83] A decade later, in 1986, a chapter in a WHO report would claim that of

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[79] R. G. Powell et al., "Structures of Harringtonine, Isoharringtonine, and Homoharringtonine," *Tetrahedron Letter* 11 (March 1970): 815–18.

[80] Guangdong Pharmaceutical Industry Corporation Foshan Pharm. Factory, "从三尖杉中分离抗癌成分粗榧碱" [Isolation of the Anti-Cancer Component Cylindine from Cephalocorpus cerevisiae], *Chin. Herb. Med. Newsl.* 2 (1972): 19.

[81] Editors, "消息点滴" [Bits and Pieces of News], *J. Pharm. Industry* (1972), no. 7: 44.

[82] Cancer Research Coordinating Group, "Cephelotaxine Esters in the Treatment of Acute Leukemia: A Preliminary Assessment," *Chin. Med. J. (Eng. Ed.)* 2, no. 4 (1976): 263–72.

[83] Dept. of Pharmacology, Institute of Materia Medica, "The Antitumor Effects and Pharmacological Action of Harringtonine," *Chin. Med. J. (Eng. Ed.)* 3, no. 2 (1977): 131–36; People's Liberation Army 187th Hospital, "Harringtonine in Acute Leukemia: Clinical Analysis of 31 Cases," *Chin. Med. J.*

"104 new drugs developed in China since 1949, 60 directly or indirectly [came] from folk medicine" and used Harringtonine as its leading example. The chapter was authored by the former director of the IMM, who also wrote, at the bottom of the same page, that "basic research in traditional Chinese medicine is closely connected to its unique theory and tradition."[84]

Harringtonine is here re-networked into CM even more forcefully than Camptothecin, and made an exemplar of another then-nascent "cold war," this time between CM and international biomedicine. These new battle lines were drawn partly because CM was experiencing a new global popularity and respect by the mid- to late 1980s, partly spurred by WHO recognition. Lost in this process was an alternate story of an international bioprospecting and drug screening effort with joint American and Chinese participation. Linking anti-cancer drugs to tradition was no longer a domestic political imperative so much as an element in the projection of Chinese soft power abroad, in which TCM would play an increasingly important role.

Zootherapy: Animal Tissue in Anti-Cancer Drugs

When Chinese medicine was showcased to Western visitors during China's period of opening in the mid- to late 1970s, the emphasis was placed on acupuncture therapy, the Barefoot

(Eng. Ed.) 3, no. 5 (1977): 319–24.

[84] Xiao Peigen, "Basic Research on Herbal Medicine in China," in WHO Regional Office for the Western Pacific, *World Health Organization Report: Scientific Group on Herbal Medicine Research, Tokyo, Japan 10–12 March, 1986* (Manila, 1986).

Doctor program, and herbalism in general. CM anti-cancer drug research was given much less visibility, probably because of the greater foreign interest in Chinese research on cancer epidemiology.[85] Least visible of all to foreign visitors was Chinese interest in zootherapy—the use of animal tissue as medicine for cancer and other ailments. In an otherwise well-informed article of 1976, visiting American drug researcher George Pettit wrote that "apparently no animal extracts are known to be widely used in the traditional medical treatment of cancer."[86] This was not strictly true, but if Pettit's Chinese informants withheld such information, it was likely with the awareness that the raw tissue of wild animals was too far outside what Western science would accept, in contrast to herbs. Chinese medicine doctors had long been mocked in the West for using ingredients like snakes, scorpions, and toads, so the reappearance of these same substances in anti-cancer drug research in the period we are considering was not a topic Chinese scientists would wish to have broadcast abroad. Indeed, zootherapy was almost entirely missing from any English-language report on Chinese medicine in that period, whether authored by Chinese or by foreigners.

As we have already seen, however, animals joined plants and minerals as equal fodder in Chinese anti-cancer drug development. Indeed, zootherapies grew in importance during the Cultural Revolution as more animal-based recipes were discovered through folk medicine and medicinal animal farming became more organized.[87] The turn to cancer research may even have provided additional stimulus for the use of animals, as many were classed in CM

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[85] See Jiang, "Global Epidemiology" (n. 12).
[86] Pettit, "View of Cancer Treatment" (n. 11), 795n15.
[87] For zootherapies in Chinese medicine, see Chee, *Mao's Bestiary* (n. 7).

as being powerful or toxic, and thus seemingly well matched in the fight against such a tenacious disease.

There is some irony in the fact that beginning around 1975, Western bioprospecting for anti-cancer drugs also began to turn toward animal as well as plant sources. Yet neither side recognized nor sought to comment on this limited convergence in zootherapy research.[88] This new Western interest in fauna was not so much a turn, however, but as Newman and Cragg describe it, "simply [an] extension of tried-and-true phytochemical (i.e., flora-based) techniques. Thus, easily accessible organisms (generally sponges and encrusting organisms such as ascidians) were collected by hand using snorkel or simple scuba systems, and then their chemical components were extracted and identified. Any biological activity was found as an afterthought in these initial experiments (though as shown above, active compounds could be found by these techniques that would ultimately be useful as treatments for human diseases)."[89] In other words, the first animals collected and found promising in Western anti-cancer research were sponges and other creatures that were exceedingly *plantlike*. Such stationary marine organisms would continue to form the vast majority of "animals" bioprospected by Western researchers. This of course left a considerable gap between the zootherapeutic research in North America and Europe and that of China, where all manner of

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[88] Western bioprospecting of (mostly marine) animals and analysis of animal tissue for anti-cancer drugs began in 1975, and by 1980, 16,500 extracts had been taken from about 3,000 species, which ultimately yielded only seven "useful compounds." Paul Keating and Alberto Cambrosio, *Cancer on Trial: Oncology as a New Style of Practice* (Chicago: University of Chicago Press, 2011).

[89] David J. Newman and Gordon M. Cragg, "Marine Natural Products and Related Compounds in Clinical and Advanced Preclinical Trials," *J. Nat. Prod.* 67 (2004): 1216–38, quotation on 1216.

land animals—including mammals soon to be recognized as endangered species—became raw material for lab analysis and testing, particularly if they had been referenced in classical or folk medicine.

The Chinese search for an effective antimalarial drug, for example, which eventually resulted in Artemisinin, initially involved the screening of many other materials referenced in traditional medicine, including animals. Tu Youyou herself screened pill bugs (*armadillium vulgare*), earthworms, the sloughed skin of snakes, and even pangolin scales before settling on the plant that would eventually win her a Nobel Prize.[90] If any of these materials had proven bioactive (which they didn't), it would have sent shock waves through the global drug discovery culture of the 1970s, which had largely bypassed terrestrial animals and had come late, and very selectively, to marine ones.

In refining both Drug 713 and Indirubin in Chinese labs, both the traditional recipes under study included an animal ingredient. But like those screened in the search for an antimalarial drug, each faunal element was eliminated in laboratory trials as inactive. In the case of Drug 713 it was toad venom, and in Indirubin it was musk, the product of musk deer, which had been farmed for medicinal purposes in China since at least the Great Leap Forward.[91] It was unlikely in either case that the researchers were concerned about Western opinion, but only that the tissue proved too toxic, in the case of Drug 713, and too expensive (as well as inactive), in the case of Indirubin.

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[90] Rao, Zhang, and Li, *Tu Youyou* (n. 4), 34.
[91] Chee, *Mao's Bestiary* (n. 7).

The disappearance of animal tissue from the screening processes of some labs, however, belied a renewed enthusiasm for their use by others. A 1971 "Introduction to Chinese Medicine in the Treatment of Leukemia," for example, reported that "toad venom is made into various dosage forms in Shanghai, Guangzhou, Shenyang, Beijing, and other places to treat malignant tumors, leukemia, etc."[92] A Shanghai factory even produced toad venom in tablet form for clinical use.[93] Particular attention was attached in this period to the blood of fowls, especially chickens and geese, as well as to insects. Chicken blood therapy, which involved injecting the blood of chickens directly into humans, was originally not targeted toward cancer but to cure "100 diseases" according to its inventor and popularizer, Dr. Yu Chang-sh. But by the Cultural Revolution, Yu added cervical and stomach cancer to the list of conditions it could cure.[94]

A substance targeted more specifically as an anti-cancer agent was goose blood, which rose to prominence in the early 1970s in parallel with epidemiological studies indicating a high prevalence of esophageal cancer in specific areas of rural North China. The major proponent of "goose blood therapy" was Dr. Zhang Mengnong of the Hubei Chinese Medical College, who based his analysis on classical CM references to *yege* (a classical condition he interpreted as esophageal and gastric cancer) and even anecdotes from Qing-period novels.

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[92] Dongzhimen Hospital, Research Institute of Chinese Medicine, "中医药治疗急性白血病简介" [Introduction to Chinese Medicine in the Treatment of Leukemia], *Med. Res. Letters* (1972), no. 3: 5, 8.

[93] Ibid.

[94] Chee, *Mao's Bestiary* (n. 7), chap. 4, esp. 110; Liz P.Y. Chee, "To Cure a Hundred Diseases: Animal Blood Therapies in Mao's China", *Science, Technology & Society* 23, no. 2 (2018): 195-213.

But goose blood as an anti-cancer agent was also experimented on as a joint project of the pathology department of the Shanghai Navy Hospital and the Zhejiang University School of Medicine. Their final report, in 1974, suggested the possibility of an "anti-cancer gene" in goose blood, based on positive results in clinical trials.[95] Although never reported in English-language medical journals, research on goose blood as an anti-cancer agent continued into the early part of this century. Hubei Chinese Medical College patented "goose blood preparation" as an anti-cancer drug in 1998, and a researcher at Heilongjiang Provincial Tumor Institute claimed in 2003 to have used it to treat over one hundred patients with liver cancer. As is typical in publications from the 1980s until today, this last article made no reference to the Cultural Revolution origins of the therapy.[96]

Conclusion

Beginning in the 1980s, the global marketing of Chinese medicine would elevate its status to the extent that it became an "alternative" to Western medicine far beyond China. The lure of traditional versus ancient knowledge, and "naturalness" versus the chemically synthetic became important components in the charisma of the globalizing TCM brand. Chinese materia medica also took on the role of a possible cure for conditions that Western medicine had failed to fully understand or master. Among the most prominent of those conditions was of course cancer. Drug 713/ATO/Trisonox remains one of very few Chinese-origin medicinals

[95] Chee, *Mao's Bestiary* (n. 7), chap. 4.
[96] Xinhua News Agency, "Cancer-Curing Agent Found in Goose Blood," April 15, 2003, https://china.org.cn/English/scitech/62235.htm (accessed October 3, 2022).

to have made the transition to globally recognized chemotherapeutical drug. But claims for the anti-cancer properties of "traditional" Chinese medicinals of many types are now more commonly and boldly made in the wider medical marketplace than ever before.

"Traditional Chinese medicine (TCM) has been practiced for thousands of years and at the present time is widely accepted as an alternative treatment for cancer," begins a recent abstract in a prominent international oncology journal.[97] What is missing between the statement's ancient and contemporary bookends is the key role of the Mao-period CM physician-researchers, and later "integrated" teams of CM and biomedical physicians (sometimes in "revolutionary teams" with workers) in crafting materia medica into anti-cancer therapies. Such therapeutic drugs were recognized and celebrated at the time as new discoveries—having been either excavated from folk knowledge or experimentally refined and reformulated from classical recipes—even as they were simultaneously seen as extending forward an indigenous medical lineage. The "treasure chest" of materia medica, as Mao described it, was understood by physician-researchers to be a currency requiring reminting in order to purchase relief or cure from cancer, either in competition with chemotherapy or alongside it. Additional treasures were added to this inheritance in the form of foreign anti-cancer drugs derived from Chinese trees that had been bypassed by Chinese medicine. Other objects in that chest, namely animal tissue, were largely expunged, at least in accounts meant for foreign readership. This illustrates the complexity of tradition as a referent in the drug

[97] Y. Xiang et al., "Traditional Chinese Medicine as a Cancer Treatment: Modern Perspectives of Ancient but Advanced Science," *Cancer Med.* 8, no. 5 (2019): 1958–75.

discovery process, not only in the period we've been examining, but as vitally in the era of a globalized TCM.

In contrast to the ahistorical way that CM anti-cancer therapies are now often presented, we have shown that the foray of CM physician-researchers into oncology was initially a hesitant one, even with the political impetus and encouragement of the Great Leap Forward. This was likely due to cancer having become a strong target for Chinese biomedical research in the late 1950s, yet a relatively new and hazy object for CM, despite much discussion in classical texts about tumors. The grim prognosis of cancer may have also warned away herbalists, although the stray reports of CM curing patients abandoned by Western medicine hospitals in this period presaged CM's subsequent identity as a medicine of last resort, and the source of miracle cures. Thus the GLF did see Chinese materia medica begin to be excavated for anti-cancer agents, though the nascent CM physician-research community failed to come together around any one formula or solution.

The Cultural Revolution, as we've shown, saw an expanded and more sustained application of traditional materia medica in cancer research, largely due to the politically enforced "integration" of Chinese and Western medicine, and the ideological turn to folk medicine and "learning from the masses." Integration, however, meant that research in materia medica was increasingly framed within biomedical protocols. CM drug therapies began to be used as adjuncts to chemotherapy practiced with Western-derived drugs. In other instances, integrated teams of CM and Western doctors canvassed widely for folk recipes and pulled apart classical formulas searching for herbs or animal compounds that could cure

cancer outright. Promising substances were screened for possible reduction to single active ingredients, in processes reliant on biomedical lab techniques.

Both Chinese and Western efforts, however separate, can also be seen as part of a global bioprospecting initiative spurred by the promise of chemotherapy. In the Chinese case, the target was mainly the materia medica of the CM and folk pharmacy, while Western-organized bioprospecting was broad-gauged and not overly influenced by ethnobotany or ethnomedicine. Both were productive of results. Drugs 713 and Indirubin, for example, might never have been discovered if research had not begun with traditional formulas. Camptothecin and Harringtonine, on the other hand, were discovered by foreign scientists using Asian species of tree overlooked by CM, but refined and further developed for clinical use in Chinese labs. By the late Cultural Revolution, the Chinese effort was increasingly influenced by the transnational circulation of raw materials, scientific papers, and laboratory or clinical samples as well as visiting delegations. The revolutionary language of CM anti-cancer drug development would prove strong enough to absorb even Western advances (using Chinese materials) into what would become a global discourse on "Traditional Chinese Medicine."

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