MAKING SCIENCE POPULAR: READERS, NATION, AND THE UNIVERSE IN CHINESE POPULAR SCIENCE PERIODICALS, 1933 – 1952.

NOA NAHMIAS

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ABSTRACT

In 1933, a group of scientists and educators based in Shanghai published a magazine they hoped would spread science to China's "ordinary" people, entitled *Kexue huabao* 科學畫報. The direct translation of the title is "Science Pictorial," but the publisher included an English title – *Popular Science* – on the cover of this Chinese language journal. This dissertation deconstructs what "popular science" meant in Republican China through three sets of questions: who participated in popularizing science in China? Who were their audiences? And what kinds of narratives about science emerged in popular publications? I use the journal as an entry point to examine how scientists, politicians, publishers, and writers undertook the mission of "scientizing China." Treating the journal as an archive, I mine its texts, images, regular columns, formatting, para-textual elements, readers' letters, circulation figures, and its relationship to other science dissemination projects. I find that science popularizers viewed images and objects as integral to transmitting scientific knowledge and crucial to reaching their target audiences. *Kexue huabao* attempted to appeal to women, children, and "ordinary people" by mobilizing the notion of science as everyday knowledge. In the process of bringing scientific knowledge to China, the publisher engaged a transnational repository of texts and images and used these to construct a vision of science as universal. The dissertation demonstrates that in 20th century China, science was seen not only in terms of nation-building but also as a global framework of knowledge.

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SMA	Shanghai Municipal Archives
SHA	Second Historical Archives, Nanjing
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ZKDZ: FZLC	*Zhongguo kexueshe dang'an ziliao zhengli yu yanjiu: fazhan lichen shiliao* 中国科学社档案资料整理与研究: 发展历程史料 [Records and Research on the China Science Society: Historical Material on the Society's Development]. Edited by Lin Licheng 林丽成, Zhang Liyan 章立言, and Zhang Jian 张剑. Shanghai: Shanghai Science and Technology Press, 2015.
ZKDZ: SX	*Zhongguo kexueshe dang'an ziliao zhengli yu yanjiu: shuxin xuan bian* 中国科学社档案资料整理与研究：书信选编 [Records and Research on the China Science Society: Selected Correspondence]. Edited by Zhou Guifa 周桂发, Yang Jiarun 杨家润, and Zhang Jian 张剑. Shanghai: Shanghai Science and Technology Press, 2015.

Introduction

In August 1933, a new journal entitled *Kexue huabao* ("Science Pictorial" 科學畫報), printed and published in Shanghai, appeared in bookstores, magazine stands, and train stations in China's major cities.[1] Although there were at least a dozen publications dedicated to science already on the market, the editors promised that their journal was different. Existing publications catered to university students and educated professionals, and were too specialized for the average reader. *Kexue huabao* would introduce scientific knowledge in easy-to-understand language to those who required it most. It may appear, the editors wrote, that science had no bearing on the lives of "ordinary people" (*yiban minzhong* 一般民眾), but in fact they were the ones most in need of science to help them solve problems in their daily lives.[2] The editors believed that understanding biology could help peasants control pests, and knowing the principles of mechanics would increase the productivity of factory workers. The journal promised to demystify science, turning it from a mysterious and opaque topic to an integral part of people's lives.

Kexue huabao was not the first science journal to be published in China. In the 1930s, books on science intended for broad, but educated, audiences, flooded the market.[3] There were dozens of journals on science, but as the editors of *Kexue huabao* noted, most of them were published by professional associations or universities, and only a few were printed by commercial

[1] The direct translation of the journal's Chinese title, *Kexue huabao* 科學畫報, is Science Pictorial. However, like many journals at the time, the magazine had an English title on the cover, which was Popular Science. I have chosen to use the Chinese title to facilitate an analysis of how the neologism *kexue* (science 科學) was imbued with meaning for Chinese readers.
[2] Wang Jiliang 王季梁, "Fa kan ci" 發刊詞 [Opening Remarks], *Keuxe huabao* 1 no.1, 1933, 1.
[3] Wang Chunqiu records 312 popular science books published between 1919 and 1932, an average of 16 titles per year. This number does not include journals. Wang Chunqiu 王春秋, "Zhonguo jindai kepu duwu fazhan shi" 中國近代科普讀物發展史[The History of Popular Science Publications in Modern China], MA Thesis, (Shanghai: East China Normal University, 2007): 28.

publishers for broad audiences.[4] In the competitive environment of the 1930s Shanghai print market, how did the publisher of *Kexue huabao* differentiate the magazine? To make scientific knowledge accessible and appealing, the journal was designed as a pictorial in which images were just as important as words.[5] Articles would use simple language, and the visuals would be interesting and easy to decipher. Bringing science to audiences of "ordinary people," which included workers, peasants, and children was the only way to "truly scientize (*kexue hua* 科學化) China", the opening editorial declared.[6]

What did it mean to "scientize China"? who needed scientific knowledge? what kind of scientific knowledge was construed as necessary for the so-called ordinary people? These are the questions that this dissertation addresses through a close examination of the texts, visuals, and objects that science popularizers presented to non-professional audiences.

The term science was as ubiquitous as it was nebulous in Republican era China. The word for science, *kexue* 科學, was a neologism introduced from Japan in the late 19th century.[7] Chinese students returning from Japan around 1900 used it instead of earlier terminologies such as *gezhi* 格致, which had connotations of classical Confucian learning. By the late 1920s, *kexue* was the preferred term to denote modern science.[8] Even as the word for modern science became more fixed,

[4] Wang Lunxin 王倫信 Chen Hongjie 陳洪杰 Tang Ying 唐穎 and Wang Chunqiu 王春秋, *Zhongguo jindai minzhong kepu shi* 中國近代民眾科普史 [A History of Science Popularization for the Masses in Modern China] (Beijing: Kexue puji chubanshe, 2007), 133 - 149.
[5] Pictorial magazines were common and successful during the Republican Era. While these publications were considered frivolous by intellectuals at the time, and in turn by historians of modern China, more recently historians have shown them to be reflections of the dynamic modernity that emerged in urban China. Paul Pickowitz, Kuiyi Shen, and Yingjin Zhang, "*Liangyou*, Popular Print Media, and Visual Culture in Republican Shanghai," in Pickowitz, Shen, and Zhang, eds. *Liangyou, Kaleidoscopic Modernity and the Shanghai Global Metropolis 1926 – 1945* (Leiden: Brill, 2014), 1.
[6] Wang, Jiliang, "Fakan ci," 1.
[7] Federico Masini, "The Formation of Modern Chinese Lexicon and its Evolution toward a National Language: The Period from 1840 to 1898", *Journal of Chinese Linguistics Monograph Series* no. 6 (1993): 185.
[8] Benjamin Elman, "Toward a History of Modern Science in Republican China," in Jing Tsu and Benjamin Elman, eds. *Science and Technology in Modern China, 1880s-1940s* (Leiden: Brill, 2014), 24 - 25.

debates over what science meant and how it can be best implemented continued in academic circles and elite publications.[9] But science belonged not only in privileged debates of elite intellectuals. It was also a fashionable hobby for genteel men and women, and was used in marketing of new and modern products.[10] The government also had a stake in defining science. The Nationalist party (Guomindang 國民黨) headed by Chiang Kai-shek, incorporated science into their nation-building agenda and established different programs to disseminate the kinds of scientific knowledge they deemed necessary.[11] The Republican period therefore represents a moment when science was being utilized and defined in different contexts. Examining the ways that science was represented to lay audiences at this time is crucial to understanding how it gained its cultural authority in the 20th century, a position it still holds today.

This dissertation focuses on science popularization in the Republican era through the early years of the People's Republic of China, from 1927 to 1952. It centers on the journal *Kexue huabao*, which was published by the China Science Society from 1933 to 1952. In 1952 it was transferred to the Shanghai Association for the Dissemination of Scientific and Technological Knowledge (Shanghai shi kexue jishu puji xiehui 上海市科學技術普及協會), an organ of the Chinese Communist Party. The journal stopped publication in 1966 due to the Cultural Revolution but resumed in 1972 under a different name. In 1978, it was re-established as *Kexue huabao*, and has been in print continuously ever since.[12] The journal had a print run of around 20,000 copies per

[9] D.W.Y Kwok, *Scientism in Chinese Thought 1900-1950* (New Haven: Yale University Press, 1965), 20 – 24.
[10] Eugenia Lean, *Vernacular Industrialism in China: Local Innovation and Translated Technologies in Making of a Cosmetics Empire 1900 – 1940* (New York: Columbia University Press, 2020), 161-166.
[11] Fan Tiequan 范铁权, "20 shiji 30 niandai kexuehua yundong zhong de shetuan canyu" 20世紀30年代科學化運動中的社團參與 [Organizations Participating in the Scientization Movement in the 1930s], *Kexue xue yanjiu* 28 no.9 (2010): 1302-1303.
[12] Cheng Shengbo 成繩伯 and Rao Zhonghua 饒忠華, "*Kexue huabao* wu shi nian" 科學畫報五十年 [Fifty Years of Kexue huabao], *Zhongguo keji shiliao* 4, no.4 (1983): 28.

issue from 1933 to 1937, dropping to around 5000 during the Second Sino Japanese War. After the war, circulation numbers went up to 10,000 copies, and increased again after 1953.[13] It was sold in cities across China and in East Asia.

The journal's continuous publication during the Second Sino-Japanese War (1937-1945), and after the establishment of the People's Republic of China in 1949, make it a valuable source in tracing the impact of changing political circumstances on science popularization. But *Kexue huabao* is valuable as a historical source not just due to its long print run. By mining the publication's recurring columns, editorials, short editorial notes, letters from readers, covers, images, and circulation information, the dissertation reveals how science was presented to lay audiences. Furthermore, it aims to uncover who were the actual readers of the journal and what drew them to science. The dissertation demonstrates that in the 1930s and 1940s there was a dynamic community of non-professionals who saw science as useful and important. They conducted their own experiments, drew plans and diagrams, and read books and magazines; either as a hobby or to help them solve problems they encountered in their lives and work. I highlight the role editorial practices had in both nurturing this community and restricting it.

Kexue huabao is also significant as a window unto the question of what it meant to scientize China. It offered readers a cosmopolitan view of science, while also negotiating the meaning of Chinese science. *Kexue huabao* used a variety of foreign texts and visuals, which were adapted, translated, and presented alongside locally produced articles and images. An analysis of these materials reveals a complex negotiation of categories such as Western, foreign, and Chinese science in the journal. *Kexue huabao*'s publisher and editors believed that science was universal

[13] Zhang Jian 張劍, *Sai xiansheng zai Zhongguo: Zhongguo kexue she yanjiu* 賽先生中國：中國科學社研究 [Mr. Science in China: A Study of the China Science Society] (Shanghai: Shanghai Scientific and Technical Publishes, 2018), 543.

and aimed to incorporate their readers into a global discourse of popular science. I argue that scientizing China was not just a project of "localizing" scientific knowledge for the consumption of Chinese audiences, but also one that aimed to incorporate the Chinese public into an imagined universal community of popular science readers.[14] To understand the journal's unique point of view, and to explore the multiple visions of science popularization that existed in 20th century China, I contrast *Kexue huabao* with government-sponsored popular science activities, namely exhibitions and magazines.

I define science popularization as projects that aimed to introduce knowledge coded as scientific to audiences who had little or no formal education in science. I explore popularization through three main questions. First, who were science popularizers, and who were their audiences? The people involved in science popularization had ties to academic scientists. Many of them obtained undergraduate or graduate degrees in science abroad, and belonged to a similar cohort as professional scientists. The publishers, writers, and educators that undertook science popularization often directed their work at those they believed needed science – women, children, peasants, and urban workers. By tracing the fragmented evidence of audiences in the journal, I parse the tension between intended and actual audiences, and the relationship between science popularizers and their audiences. The readership of *Kexue huabao* was made of literate, mostly urban residents, that had obtained high primary school to university education. Even though the readers were not representative of the vast rural Chinese population, they were also outsiders to the increasingly institutionalized realm of professional science. By exploring this group – both

[14] The notion of "imagined community" is useful here in considering how print capitalism and a national language can produce communities without readers being in direct interaction with each other. Benedict Anderson, *Imagined Communities: Reflections on the Role and Spread of Nationalism* (London and New York: Verso, 2006 [1983]), 42 – 43.

popularizers and their audiences – I demonstrate that science was not only the purview of elite intellectuals, and provide an account of what kinds of "ordinary" people were interested in science.

Second, the dissertation asks: how did science popularizers make this body of knowledge accessible, tangible, and interesting to their audiences? Images and objects played a critical role in transmitting knowledge. Popularizers believed these media could make science accessible to audiences with lower literacy, communicate complex ideas easily, and provide entertainment. This dissertation treats objects in exhibition and images printed in popular science publications not as additions but as core components of the narratives created around science.

Third, I ask how science popularizers conceptualized the relationship between science, nation, and the world. The editors of *Kexue huabao* believed that their readers needed not only basic scientific knowledge, but also to have knowledge about the latest scientific news and developments from around the world. Engaging with scientific knowledge from abroad was an important part of the journal's mission. In the 20th century, Western, and later Japanese, imperialism were threatening Chinese sovereignty, and science was seen as the reason for the military superiority of imperialist nations. Science was therefore implicated in debates on China's global position. Publishers, editors, and writers created a trans-national narrative of science, while also attempting to define Chinese science. I argue that science popularizers played a critical role both in defining how science was understood in China and in the globalization of science in the early 20th century. Science popularizers in China reproduced, edited, and translated texts and images from Western Europe and the United States to reading publics across Asia, and thus created a visual and textual vocabulary shared by readers around the world.

Multiple Visions of Scientizing China

The term "scientize" (*kexuehua* 科學化) was used by various groups in Republican China, each imbuing it with a different vision of how to use science for social and political change. Sean Hsiang-lin Lei points out that using science as a verb was a linguistic phenomenon unique to East Asia, and that the term was used not only in China but also in Japan and Korea. Lei traces the term to practitioners of Chinese medicine who called to "scientize Chinese medicine" (*zhongyi kexuehua* 中醫科學化) in 1929. In their case, it served to lend Chinese medicine the authority of modernity and universality that science was associated with.[15] Scientizing, at its core, was the idea that knowledge of science was transformative: it could be used to modernize China and its people. It was therefore extremely alluring to reformers of different stripes, from neo-conservative government officials to left wing revolutionaries.

In Republican China's cities, a multitude of actors weighed in on the question of what scientization meant, including government officials, scientists, intellectuals, publishers, and other commercial actors. Different approaches to the relationship between science, modernity, and the nation engendered various brands of scientization. The radical approach, attributed to the intellectuals who were part of the May Fourth Movement, rejected the old society and pinned China's political and economic woes on adherence to outdated modes of knowledge – particularly

[15] Sean Hsiang-lin Lei, *Neither Donkey nor Horse: Medicine in the Struggle over China's Modernity* (Chicago: University of Chicago Press, 2014), 141-150.

Confucianism.[16] Science, alongside ideas such as liberalism, democracy, and individualism, was heralded as the rational and modern replacement for the old.[17]

The Nationalist party also held a stake in interpreting how to scientize China. Led by Chiang Kai-shek, the party had wrested control over most of China by 1927 and made Nanjing their capital. The Nationalists dedicated significant resources to developing professional science during the Nanjing Decade (1927 – 1937, a period of relative political stability before the Second Sino-Japanese war). They established the Academia Sinica, a centralized research institute that employed many of the brightest and most prominent scientists in China. The Republican government established links to the research community and access to the newest scientific knowledge, while the researchers were able to maintain a considerable degree of academic freedom.[18]

In addition to supporting scientific research, Nationalist party politicians viewed science as a foundational epistemology through which to enact different nation building policies. After 1927, the dominant view of science in the Guomindang can be characterized as neo-traditional. Promoting a "scientific approach to life" was important to the government, but in their interpretation, science would be used to preserve and modernize China's cultural heritage.[19]

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[16] The May Fourth Movement started with an anti-imperialist student demonstration following the Versailles Treaty which granted Japan territories in China, on May Fourth, 1919. It grew into a broader movement during the 1920s and 1930s advocating for different forms of reform and modernization. In the past several decades, scholarship on the New Culture has emphasized its multivocal nature and the diverse responses Chinese people had to the question of modernity. For an overview of some of this literature, see Hong-Yok Ip, Tze-Ki Hon, and Chiu-Chun Lee, "The Plurality of Chinese Modernity: A Review of Recent Scholarship on the May Fourth Movement," *Modern China* 29 no.4 (2003): 490 – 509.
[17] Kwok, *Scientism*, 63-64.
[18] J. Megan Greene, *The Origins of the Developmental State in Taiwan: Science Policy and the Quest for Modernization* (Cambridge, Massachusetts: Harvard University Press, 2008), 22-25.
[19] J. Megan Greene, "GMD Rhetoric of Science and Modernity (1927-1970)," in *Defining Modernity: Guomindang Rhetorics of a New China, 1920-1970* edited by Terry Bodenhorn (Ann Arbor: Center for Chinese Studies, University of Michigan, 2002), 223-225.

Nationalist party ideologues were not alone in this view of science. Other intellectuals also believed that Confucian morality could be a foundation for a rational, scientific, Chinese nation, and were interested in creating a future rooted in tradition.[20] Not surprisingly, some of these people ended up being employed by the government.

One avenue through which the Nationalist party disseminated scientific knowledge to the general population was Social Education (*shehui jiaoyu* 社會教育), a department under the Ministry of Education. Social education was meant to provide knowledge and training to people outside the formal education system. This mission took the shape of People's Education Centers (Minzhong jiaoyu guan 民眾教育館) that started being established in 1928.[21] Scientific knowledge, one of the fields of knowledge that the Republican government viewed as necessary for modern life, was an important component of these centers. However, science in the centers was oriented around the nation and knowledge that was meant to turn people into citizens. This included knowledge of the nation's geography, political structure, and indigenous plant and animal species.

The centers were established in cities and county seats, and were a combination of museum and civic center, offering classes and lectures, among other activities. There was a significant disparity in the number of centers and in their budget between the poorer provinces of the inland and the ones located in the economically prosperous East coast. For example, the budget for all the centers in Yunnan province combined was slightly less than that of the Shanghai Municipal

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[20] Wayne Soon, "Science, Medicine, and Confucianism in the Making of China and Southeast Asia: Lim Boon Keng and the Overseas Chinee, 1897-1937," *Twentieth-Century China* 39 no.1 (2014): 31-34.
[21] The People's Education Centers were not entirely new: they were a new version of an existing institution, the Popular Education Centers (Tongsu jiaoyu guan 通俗教育館), the first of which was established in Nanjing in 1915.

People's Education Center, which had a budget of 22,944 yuan.[22] This meant that there was considerable difference in what each center could offer. The People's Education Centers in Shanghai and Nanjing, both well-funded by their respective municipal and provincial governments, had dedicated science departments. But even in smaller centers located in less affluent areas, scientific knowledge was present, usually through exhibiting a few natural history specimens and charts in the health section.[23]

Disseminating scientific knowledge was part of the agenda of the People's Education Centers, but it was subordinate to the broader goal of constructing a modern, civic consciousness. In a similar example, Kate Merkel-Hess argues that literacy programs taught people not just how to read but how to "read a certain set of modern practices."[24] *Kexue huabao* and the People's Education Centers in Nanjing aimed to attract similar audiences – peasants, workers, women, and children, as well as urban, moderately educated men with no professional knowledge of science. Comparing the ways science was represented in the journal and exhibitions gives a fuller picture of the varied narratives to which "ordinary" people in Republican China's cities were exposed.

Another way that the Republican government promoted popular science was through the Association for the Movement to Scientize China (Zhongguo kexuehua yundong xiehui 中國科學化運動協會). The association was established in 1932 by Chen Lifu 陳立夫 (1900-2001), a high-ranking member of the Nationalist party and a conservative who supported a modern interpretation of Confucian ideology.[25] The association set out to "scientize people and society" (*kexuehua*

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[22] Ministry of Education, *Ershisan niandu quanguo shehui jiaoyug tongji* 二十三年度全國社會教育概況統計 [1934 Statistical Survey of Nation-wide Social Education], February 1934, 33. These statistics were collected in 1931.
[23] Wang Lunxin et. al., *Zhongguo jindai minzhong kepu* shi, 27-30.
[24] Kate Merkel-Hess, *The Rural Modern: Reconstructing the Self and State in Republican China* (Chicago: The University of Chicago Press, 2016), 54.
[25] Charles Roy Kitts, "An Inside View of the Kuomintang: Chen Li-fu, 1926 – 1949," PhD Dissertation, St. John's University, 1978: 67.

minzhong, kexuehua shehui 科學化民眾，科學化社會).[26] Members of the association, many of whom held government positions, saw science as a way to combat the "poverty, vulgarity, and ignorance" of the people, and to use scientific principles to organize and disseminate China's cultural heritage.[27] The association held lectures, exhibitions, and produced radio broadcasts about science. They also published a journal, *Scientific China* (Kexue de Zhongguo 科學的中國) starting in 1932, which was aimed at a general readership. The establishment of the Association and their journal was one of the factors that prompted the China Science Society to be more active in popularizing activities.

The two main approaches to science in Republican China were therefore the "radical approach" which generally believed Confucianism, and Chinese tradition, had little role to play in modernization, and the "cultural conservative" approach that centered Chinese heritage (or rather, a constructed, politically expedient version of it) as a basis for a modern nation-state. The publisher, writers, and scientists behind *Kexue huabao* do not fit neatly into any of the above approaches to science. The categories themselves are somewhat of a narrative strategy meant to impose order on a historical era which had more contradictions that unity. But these categories can serve as goal posts marking two extremes. Many of the intellectuals and scientists in the first half of the 20th century confronted complex questions of tradition and modernity; China and the West; and the past and the future. Their opinions changed over time and they did not always offer straightforward solutions to these contradicting forces.

[26] Peng Guanghua 彭光華, "Zhongguo kexuehua yundong de chuangjian, huodong jiqi lishi diwei" 中國科學化運動的創建活動及其歷史地位 [The Establishment, Activities, and Historical Significance of the Movement to Scientize China], *China Historical Materials of Science and Technology* vol. 13. no.1 (1992): 60.
[27] Peng, "Zhongguo kexuehua," 63.

Kexue huabao presented a view of science that was different both from the iconoclastic rejection of the past of the New Culture Movement, but was also more cosmopolitan and expansive than the Republican's government neo-conservative approach and utilitarian view of scientific knowledge. In the following chapters, I will contrast *Kexue huabao*'s narratives on science with government science dissemination projects to demonstrate that there were various interpretations of what "scientizing" meant, and to highlight what was unique to the publisher and editors of the journal.

<u>Popular Science – for whom, by whom?</u>

The science popularization projects I will focus on represent a top-down dissemination from authorities – either the government or experts – to lay people. Both the Republican government and the publisher of *Kexue huabao* saw China's ordinary people as ignorant of science, and positioned their publications and exhibitions as sources providing the correct and modern way of understanding the natural world. Although the term popular science is ambiguous and its use as an analytical framework has been criticized, it can nevertheless be fruitfully applied to describe the way the actors involved in the journal approached their mission, and their interaction with their audience.[28]

In the case of Republican-era China, I argue that popular science is an apt term both as an actor's category and an analytic framework. The publisher of *Kexue huabao*, Yang Xiaoshu 楊孝述 (1884-1974), translated the magazine's name to *Popular Science* in English and *La Science Populaire* in French. He explicitly mentioned British and American popular publications as

[28] One such critique was Roger Cooter and Stephen Pumfrey's essay which argued that using the term popular science created an artificial boundary separating professional and lay knowledge. Cooter and Pumfrey, "Separate Spheres and Public Spaces: Reflections on the History of Science Popularization and Science in Popular Culture," *History of Science* 32 (1994): 239.

inspiration for his journal. Popular science, in this case, was not imposed from the outside on the Chinese context. It was adopted by Chinese writers, editors, educators, and publishers as a way to frame their own work and connect it to global trends in publishing.

As an analytical category, using popular science allows us to investigate and question the boundary between scientific authority and the public. As Sigrid Schmalzer argues, it is a way to study "not just any exchanges, but specifically exchanges, variously configured, between recognized authorities and people outside that privileged circle."[29] In Republican China a confluence of historical contingencies makes the question of who has the authority to speak on behalf of science was especially important. During the 1930s the research infrastructure in China expended with the establishment of research institutes and experimental science departments in universities. At the same time, a stronger centralized government was also laying claim to defining scientific research priorities. A focus on scientific knowledge that was meant for lay audiences allows us to explore how different groups – government representatives, professional scientists, and publishers – defined what science was.

In the past few decades, historians have deconstructed the assumptions associated with popular science, namely that it reifies a dichotomy of lay and professional, and that it positions audiences as passive recipients of expert knowledge. In the context of Victorian Britain, James Secord's work on evolution demonstrates that popular print publications impacted elite scientific discourse, arguing against an assumption of unilateral dissemination of knowledge from the academic to the public sphere.[30] Bernard Lightman's work demonstrates the critical role that actors

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[29] Sigrid Schmalzer, "Popular Science, A Useful and Productive Category After All," *Historical Studies in Natural Science* 42 no.5 (2012): 591.
[30] James Secord, *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation* (Chicago: University of Chicago Press, 2000), 3-5.

outside academic circles, such as professional writers and women, played in circulating natural knowledge.[31] Popularizers in Victorian Britain challenged the authority of men of science by representing a different interpretation of the meaning of science. Marcel C. LaFollette, writing about representation of science in American magazines during the interwar years, showed that publishing concerns and reader expectations were crucial in determining the kinds of scientific articles printed.[32]

These studies have shown that in the Euro/American context, throughout the 19th and early 20th century, formal and popular science did not operate separately from each other. However, their relationship was mostly antagonistic and characterized by competition for authority and readers.[33] What is unique about the Chinese case, is that despite an emerging professional science sphere in the 1920s and after, academic scientists were not in competition with popularizers. The interests of professional scientists and those who wrote, edited, and published on science for a broader audience were often aligned, and many professional scientists participated in writing for broader audiences. Robert Culp's work on the publishing industry in Republican-era China argues that writing general introductions allowed academics to gain recognition as leaders in their field, as well as another source of income.[34] Patriotism and a sense of duty to educate was another reason. Chinese scientists saw themselves as responsible for bringing modern scientific knowledge to their compatriots. The assumed competition between popular and professional does not map onto China.

[31] Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2007), 34-38.
[32] Marcel C. LaFollette, *Making Science our Own: Public Images of Science 1910-1955*, (Chicago: University of Chicago Press,1990), 20-23.
[33] Jonathan R. Topham, "Rethinking the History of Science Popularization/Popular Science," in *Popularizing Science and Technology in the European Periphery 1800–2000*, eds. Faidra Papanelopoulou and Agusti Nieto-Galan (London: Routledge, 2009), 8-9.
[34] Culp, *The Power of Print*, 175.

A different problem for historians working on the 20th century is how to critically examine popular science in a historical context of increased professionalization and division into specialized disciplines, which granted scientists expert status. How do we study cases that resemble the model that was criticized for being reductive, of top-down dissemination from scientists to lay audiences? Interrogating the conditions which allow scientist's authority to be recognized reveals how the boundary between lay and expert is maintained. Peter Bowler argues that the increase of education and social mobility opportunities in 20th century Britain created a reading public that was receptive to accessible works written by scientists.[35] Focusing on the ways that readers' needs shape publications provides crucial nuance to the top-down model. In her work on human evolution in popular media in socialist China, Sigrid Schmalzer argues that top-down dissemination of knowledge by experts (who were not necessarily professional scientists) was the main mode of science popularization even when notions of grassroots science were promoted by the central government.[36]

Building on the work of Schmalzer and Bowler, I interrogate the top-down approach of science popularization to understand who participated in it, and who were the intended, and actual, audiences. I reveal a diverse group of actors located between the professional and popular sphere, and show that science offered educated Chinese new professional opportunities. Furthermore, I argue that even as science was becoming more institutionalized throughout the 1930s and late 1940s, the continued importance of popularizing science created a space in which non-professionals could participate in knowledge making. By uncovering the connections between professional scientists and popularizers, and identifying the kinds of audiences for popular science

[35] Peter Bowler, *Science for All: The Popularization of Science in Early Twentieth-Century Britain* (Chicago: The University of Chicago Press, 2009), 4.
[36] Sigrid Schmalzer, *The People's Peking Man: Popular Science and Human Identity in Twentieth-Century China* (Chicago: University of Chicago Press, 2008), 114-125.

magazines, this project argues for viewing popular science in Republican China as a continuum rather than two separate spheres.

Science in China: Beyond Saving the Nation

Why was science important in China's turn of the 20th century? It was important to political leaders and intellectual elites as a path to saving China from political demise and imperial encroachment, as a way to modernize and compete with foreign powers.[37] But as Grace Shen pointed out, assuming that Chinese elites were interested in science because of its inherent superiority as a knowledge system is not historically accurate, and it serves to cement the narrative of modern science as the most authoritative form of knowledge.[38] An additional problem of focusing on science as a solution to China's political woes is that we risk overlooking the myriad other reasons that "ordinary" people were interested in science: to solve problems in their daily lives, as a path to employment and new lucrative careers, or as an enjoyable hobby. By examining what science meant outside the realms of political and academic elites, this project uncovers the social traction, cultural power, and affective resonance attached to scientific knowledge.

Scholarship on science in China has taken one of two routes, both of which focus on intellectuals and professional scientists. The first is an intellectual history approach that examines the way modern science was understood by academics, revolutionaries, and politicians. Scholars have asked how modern science was interpreted by intellectuals and used as a discursive tool in debates on modernity.[39] Kwok's work on the different approaches to science among Chinese

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[37] Benjamin Schwartz, *In Search of Wealth and Power: Yen Fu and the West* (Cambridge: Harvard University Press, 2009 [1965]), 27-28.
[38] Grace Shen, "Murky Waters: Thoughts on Desire, Utility, and the 'Sea of Modern Science'," *Isis* 98 no.3 (2007): 590.
[39] Wang Hui, "Discursive Community and the Genealogy of Scientific Categories," in *Everyday Modernity in China*, eds. Madeleine Yue Dong and Joshua L. Goldstein (Seattle: University of Washington Press, 2006), 81.

intellectuals and professional scientists is instructive in understanding the social and intellectual topography of debates on science, but it also contributed to an assumption that science in China was not practiced, but talked about.[40] Scientism, as Grace Shen argues, does not have to be a derogatory term that implies a surface level understanding of what science is. Rather, it can be used to understand the cultural and social meanings this term held.[41]

Moving away from science's social significance, more recent literature has focused on how science was practiced. These studies center on professional scientists, the development of disciplinary sciences, and institutional histories. Some works traced the connections and impact that missionaries and foreign agencies had on the establishment of Biology and Chemistry.[42] Others have argued that scientists defined their fields and commitments in relation to the Chinese state and the international community.[43] More recently historians have started to explore science in China outside institutional frameworks. Eugenia Lean's work on publisher and industrialist Chen Diexian illuminates the "seemingly apolitical, unprofessional, and inconsequential spaces" that were central to experimenting with science, everyday knowledge, and light industry.[44] Lean's notion of vernacular industrialism connects these spaces to national concerns and global circuits of publishing and production. Fa-ti Fan has called for an integrated approach that considers trained and professional scientists, intellectuals, and cultural reformers as part of the same field of

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[40] Kwok, *Scientism in Chinese Thought*, 11-13.
[41] Grace Yen Shen, "Scientism in Twentieth Century China," In *Modern Chinese Religion II 1850-2015*, volume 1, eds. Vincent Goossaert, Jan Kiely, and John Lagerwey (Leiden and Boston: Brill, 2015), 90.
[42] Lawrence A. Schneider, *Biology and Revolution in Twentieth Century China* (Lanham: Rowman and Littlefield Publishers, 2003); James Reardon Anderson, *The Study of Change: Chemistry in China 1840 – 1949* (Cambridge: Cambridge University Press, 1991).
[43] Grace Yen Shen, *Unearthing the Nation: Modern Geology and Nationalism in Republican China* (Chicago: The University of Chicago Press, 2014).
[44] Lean, *Vernacular Industrialism*, 8.

discourse. After all, they were part of the same communities and networks, and similarly confronted questions of imperialism, internationalism, and the fate of the nation.[45]

The dissertation contributes to the literature on science in modern China by arguing that science popularizers and their publications were an important part of how science was thought about and practiced. I explore the terrain of science popularization efforts during a period that saw the professionalization and institutionalization of science, but also an increasing appetite for it from non-professionals. Analyzing the motivations of popularizers and their audiences provides a more nuanced understanding of who was interested in science in Republican China, and why. Furthermore, building on previous studies that highlight the importance of both national and international frameworks, this study demonstrates that science popularizers, through their links to foreign research institutes and their use of an array of foreign materials, promoted a universal vision of science alongside the narrative of science for the nation.

Limits of the Global: A Chinese Universalism

What did it mean to introduce readers to the "world" of modern science? how did the publisher and editors of *Kexue huabao* contend with questions of where science originated, and China's place in producing scientific knowledge? From the beginning of the 20th century, Chinese intellectuals were debating whether China could be scientific, or if science was a unique characteristic of the West.[46] An editorial published in *Kexue huabao* in 1933 rejected an essentialist view of an inherent scientific "attitude" (*taidu* 態度) that Chinese people lacked. The author argued that even though the scientific method came from the West, it did not mean Chinese

[45] Fa-ti Fan, "How did the Chinese Become Native? Science and the Search for National Origins in the May Fourth Era," in *Beyond the May Fourth Paradigm: in Search of Chinese Modernity*, eds. Kai-wing Chou, Tze-ki Hon, Hung-Yok Ip, and Don Price (Lanham: Lexington Books, 2008), 184.
[46] Feng Youlan (Fung Yu-Lan), "Why China has no Science: An Interpretation of the History and Consequence of Chinese Philosophy," *International Journal of Ethics* 32 no.3, (1922): 237 – 238.

people could not use it to do science.[47] Reading *Kexue huabao* provides a way to understand the complex ways Chinese scientists and popularizers thought about universal knowledge, Western science, and the potential of Chinese science.

The history of science as a discipline contained an uneasy tension between claiming science was universal and viewing modern science as a Western invention. George Sarton, one of the founders of history of science as a modern scholarly field believed that the search for scientific truths was universally-shared human trait.[48] Joseph Needham produced an ambitious, multi-volume history of science in China, but also argued that China "failed" at achieving modern science.[49] Despite an early interest in the field in science outside the West, the common narrative became one of modern science spreading from Western Europe to the rest of the world.[50]

Following the post-colonial turn, historians of science have contested this narrative from different angles. Studies have demonstrated that local interlocuters of European naturalists had a critical role in how specimens were collected, and the meanings and findings these objects generated.[51] Scholars acknowledged the role of mobile actors in informal settings, or "go-betweens," in creating new knowledge.[52] Focusing on these local agents, Kapil Raj argued that modern science was not "invented" in the West but was a product of a transnational, reciprocal,

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[47] Ren Hongjun 任紅雋, "Kexue de zhongzi zai nali" 科學的種子在哪裡 [Where are the Seeds of Science?], *Kexue huabao* 1 no.8 (1933):1.
[48] George Sarton, "The New Humanism," *Isis* 6 no.1 (1924): 24, 31-32.
[49] Joseph Needham, *The Grand Titration: Science and Society in East and West* (New York and London: Routledge, 2013 [1969]), 16.
[50] George Basalla, "The Spread of Western Science," *Science* 156 no.3775 (1967): 611.
[51] Fa-ti Fan, *British Naturalists in Qing China: Science, Empire, and Cultural Encounter* (Cambridge: Harvard University Press, 2004), 5.
[52] Simon Schaffer, Lissa Roberts, Kapil Raj, and James Delbourgo, "Introduction," in *The Brokered World: Go-betweens and Global Intelligence, 1770-1820* eds. Simon Schaffer, Lissa Roberts, Kapil Raj and James Delbourgo (Sagamore Beach: Science History Publications, 2009), x-xi.

process.[53] The focus on the process of creating scientific knowledge, and the various actors involved in it, have allowed the discipline to question whether modern science was indeed invented in the West.

Another response questioned the contention that Western science was a stable body of knowledge that spread to the rest of the world and replaced local knowledge. Scholars have shown that in many different geographical contexts, including the Middle East, India, and China, elites negotiated foreign knowledge through existing knowledge frameworks, whether religious or medical.[54] Bridie Andrews' study, for example, argues that interactions between foreign and local actors produced hybrid models of biomedicine and Chinese medicine.[55]

Following these studies, I examine how Chinese science popularizers in the 20th century imbued categories such as Western, foreign, and local, with different meanings. These categories represented shifting geographies and were constructed by the historical actors who used them.[56] I argue, however, that there is another category to which these historical actors contributed: the universal. Studies on science internationalism have tended to focus on inter-European, or Euro-American exchanges, and on institutional settings such as national science associations.[57] Popular science projects drew from transnational circuits to furnish their print publications and exhibitions. Claiming that Chinese readers needed to know the same things about science as British and

[53] Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900* (London: Palgrave Macmillan, 2007), 13.
[54] Marwa Elshakry, *Reading Darwin in Arabic, 1860 – 1950* (Chicago: University of Chicago Press, 2013), 4-5; Lei, *Neither Donkey nor Horse*, 15.
[55] Bridie Andrews, *The Making of Modern Chinese Medicine, 1850 -1960* (Vancouver: UBC Press, 2014), 7. Mukharji articulates a similar approach to understanding modern Ayurveda. Projit Bihari Mukharji, *Doctoring Traditions: Ayurveda, Small Technologies, and Braided Sciences* (Chicago: University of Chicago Press, 2016), 2.
[56] Marwa Elshakry, "When Science Became Western: Historiographical Reflections," *Isis* 101 vol.98 (2010): 99-100.
[57] Geert Somsen, "A History of Universalism: Conceptions of the Internationality of Science from the Enlightenment to the Cold War," *Minerva* 46 (2008): 361 – 379.

American readers, popularizers viewed science as a universal system, a body of knowledge belonging to all humankind. By centering this point of view, I ask how universalism was imagined outside the West.

To understand the ways that popularizers constructed their own vision of science as universal, I examine the foreign images, texts, and objects that they used alongside locally produced materials, and track their sources and how they were adapted. By doing so I draw attention to science popularizers as active agents in circulating visuals and articles from abroad to Chinese readers. Knowledge circulation has been a key framework in studying the global movement of ideas, objects, and people, and provided a way of conceptualizing both metropole and colony as vital sites of making science.[58] But circulation has been critiqued for implying a smooth process and obscuring both the work it necessitated and the blockages that prevented circulation.[59] Centering the historical actors involved in circulation, understanding their agendas and the products they created, provides a nuanced and concrete example of what circulation entailed.

The Journal as Archive

Does a journal, composed as it is of pieces written by different authors, and compiled by one or more editors, speak with one voice? Can we talk about it as a singular entity? In her work on the scientific journal *Nature*, Baldwin suggests viewing the publication not as a homogenous body but as a collection of editorial practices that shape its tone and audience.[60] The journal then becomes an archive in itself. Paying attention to omissions, framing devices, and what gets

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[58] Kapil Raj, "Beyond Postcolonialism and Post-positivism: Circulation and the Global History of Science," *Isis* 104 no.2, (2013): 337.
[59] Fa-ti Fan, "Modernity, Region, and Technoscience: One Small Cheer for Asia as Method," *Cultural Sociology* 10 no.3, (2016): 358.
[60] Melinda Baldwin, *Making Nature: The History of a Scientific Journal* (Chicago: The University of Chicago Press, 2015), 11-12.

published gives us a glimpse into the editorial agenda in cases where archival documents may not exist. To understand the different strategies that *Kexue huabao* used to create its vision of a universal science, we must view it not as a collection of articles but as a complete product in which the overall message is greater than the sum of its parts.

Studies in print culture, particularly those focusing on journals, have offered useful methodologies that allow us to understand the narratives and tensions embedded in printed materials. Joan Judge suggests a horizontal analysis of periodicals which views them in their entirety. A horizontal reading may include covers, visuals, advertisements, columns, and para-textual elements. In addition, by situating these publications within a broader frame of contemporaneous print products, we can fully realize the complexity and innovation of ephemeral publications often deemed shallow or superfluous.[61]

My approach to *Kexue huabao* builds on these innovative methodologies. I use a horizontal reading, considering the entirety of the journal's issues, from cover to table of contents to articles and columns. I pay special attention to tracing the sources of images and analyzing them as an integral part of the text, that can confirm, subvert, or complicate the written narrative. Visuals were important to the journal's publisher because they made the magazine more appealing to audiences, but also because they could convey knowledge to readers with lower literacy rates. My analysis shows that the journal's use of both foreign and domestically produced images engendered a tension between views of science as universal and a nationally specific science.

In order to appreciate the uniqueness of their approach to scientizing China, I use an integrated analysis, comparing the journal with other publications and science dissemination

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[61] Joan Judge, *Republican Lens: Gender, Visuality, and Experience in Early Chinese Periodical Press* (California: University of California Press, 2015) 39-48.

activities undertaken by the Republican government. The dissertation finds that while in the Republican period the journal's approach to popularization was different from that purported by the government, in the 1950s, *Kexue huabao* gradually became integrated into the state organs of science popularization. But rather than being coerced into changing their vision, the editors had a role in re-defining the priorities and audiences for popular science in socialist China.

In the past few years, historians have turned to journals as sources that reveal the heterogenous nature of participants in science. Studies on scientific journals in 19th century Britain have argued that these were key sites where new communities of readers and scientists formed.[62] Serial publications are a particularly important facet of printed products, because publishers needed to create committed readers to maintain financial viability. The ongoing publication of periodicals was a format which could draw in audiences continuously with anticipation for forthcoming content. In the era before the establishment of disciplined, professional science, science journals were spaces where the boundaries between elite and non-elite, and readers with various levels of expertise, were negotiated.[63]

Research on science periodicals has shown that they played a critical role in constructing communities of science practitioners. Lightman argues that 19th century British astronomy periodicals shaped groups of readers differentiated by locale, level of expertise, and class.[64] By focusing on the editor's agenda and on communication with readers, he argues that these publications were responsible for creating "an audience for a specific scientific discipline."[65] A

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[62] Gowan Dawson and Jonathan Topham, "Introduction," in *Science Periodicals in Nineteenth Century Britain: Constructing Scientific Communities*, eds. Gowan Dawson, Bernard Lightman, Sally Shuttelworth, and Jonathan R. Topham (Chicago: University of Chicago Press, 2020), 13-15.
[63] Dawson and Topham, "Introduction," 5.
[64] Bernard Lightman, "Late Victorian Astronomical Society Journals: Creating Scientific Communities on Paper," in *Science Periodicals in Nineteenth Century Britain: Constructing Scientific Communities*, eds. Dawson et. al. (Chicago: University of Chicago Press, 2020), 301.
[65] Lightman, "Late Victorian Astronomical Society," 302.

few studies on Chinese science journals scratch only the surface of what is a rich and under-utilized source. Grace Shen examined the linguistic properties of the *Journal of the Chinese Geological Society* to argue that society members carefully negotiated interactions with foreign scientists.[66] Huang Hsiang-fu explored the kinds of scientific knowledge in women's magazine in early Republican China.[67] Zhang Jian has written the most comprehensive history to date on the China Science Society's two journals, *Kexue* ("Science" 科學) and *Kexue huabao*, examining these publications from an institutional perspective.[68]

This study uses the copious archive of *Kexue huabao* to ask about the role of science in a broader popular culture. My approach to the journal centers on how its publisher and editors constructed an idea of what science meant, and how their audiences responded to that idea. I argue that popular science in China should be viewed as a continuum, in which professional researchers, publishers, editors, writers, and readers participated in defining science. The dissertation explores editorials, readers' correspondence, and editorial notes interspersed in the journal, all of which were part of the dynamic creation of community around the journal. I uncover a group of readers who were not specialists but sought scientific knowledge and practiced it outside the privileged spaces of research institutes and universities. I ask what motivated these readers to participate in science, to what extent the magazine "created" them, and to what extent did it make them visible? And what can this group tell us about the reasons that Chinese people wanted science?

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[66] Grace Shen, "Periodical Space: Language and the Creation of Scientific Community in Republican China," in *Science and Technology in Modern China, 1880s-1940s* eds. Jing Tsu and Benjamin Elman (Leiden: Brill, 2014), 270.
[67] Huang Hsiang-fu, "Jujia bibei: *funu zazhi zai wusi qian de tongsu kexue qimeng 1915 – 1919,*" 居家必備：婦女雜誌在五四前的通俗科學啟蒙 (Household Essentials: Popular Science Education in *Funu Zazhi* 1915- 1919), 92-100.
[68] Zhang Jian, *Sai xiansheng*, 70-71.

Overview

The dissertation comprises five chapters which progress chronologically from the early 1930s to 1952. Chapter one traces the establishment of *Kexue huabao* in 1933, the journal's priorities and mission. I ask how the journal defined common scientific knowledge and how it appealed to readers. The chapter argues that *Kexue huabao* positioned itself as an international publication and promoted a view of science as universal. This was unique vision of what it meant to scientize China, particularly when compared to the Republican government's focus on the nation as the main locus of scientific knowledge. In this chapter, I analyze the journal's covers, circulation, linguistic formatting, and other material aspects, and compare them with government science exhibitions and competing journals.

The second chapter investigates how the journal negotiated the tension that emerged from the "incompatibility" of Science and China. The importance of transnational communities to the production of scientific knowledge alongside the call to use science for nation-building in China were two seemingly opposing pulls that scientists and popularizers confronted. By analyzing the journal's articles, editorials, and use of visuals, I delineate three approaches to the problem of science, China, and the world. The first placed modern Chinese science in a global context; the second suggests a shared, universal, "unscientific past" to counter the idea that China was uniquely unscientific; the third approach mobilized the idea of universalism to carve a space for Chinese science, and appealed to the notion of a "scientific spirit" to address material challenges. The journal's writers toggled competing interpretations of science as inherently transnational and its necessity to modern nation building.

Chapter three asks what happened to the view of science as universal during the Second Sino-Japanese war, from 1937 to 1945. It explores how the war impacted the material aspects of journal, and reveals an increased sense of patriotism in the journal particularly as the war was starting. The chapter then examines how different authors and editors viewed science in the face of brutal devastation brought on by new technologies. For the most part, the journal continued to view science as a benevolent force that would propel humanity forward. But the editors provided space for less optimistic interpretations as well.

Chapter four focuses on the post-war period of 1945 to 1950, and highlights the community of readers that emerged in the journal as the editors shifted their tone and priorities. I examine the kinds of readers that wrote to the journal's different columns, and how they thought about science in relation to their own lives. I argue that the readers can be thought of as "lay science practitioners," who researched, read, and conducted experiments outside of academic institutions. These readers became more visible after 1947, receiving more space and acknowledgment in the journal.

The last chapter, chapter five, traces the changes in the journal after the establishment of the People's Republic of China from 1949 to 1952. I examine the changes in the journal's mission, readership, and view of science as universal. As the publisher was replaced and new editors joined, the journal become intertwined with communist party science popularization organs. The dissemination of modern science was just as important to the new Communist regime as it was to the Nationalists, but in the first years of the PRC policies changed rapidly. The journal's editors were an integral part of the organizations that delineated new policies for science dissemination, and the same rapid shifts happened in *Kexue huabao*. Common scientific knowledge was now meant to reflect the lives of "the people:" peasants, soldiers, and workers. The journal experimented with different formats for articles and focused on content that was meant to be usable to peasants, such as farming practices, use of pesticides, and modern hygiene. Concurrently, reader participation declined, and the journal adopted a more didactic tone. But since most readers were in fact urban residents with some education, these changes were overturned. After 1950, the journal drastically reduced its use of images from British and American magazines. However, it maintained the view that transnational interactions were the basis of scientific knowledge production. Under socialism, the meaning of transnational shifted to encompass the Soviet Union and other allied states.

On the whole, this project aims to uncover what it meant to scientize China for a particular group of writers and their readers. A vibrant and diverse community, science popularizers and their readers are crucial to understanding how science became an authoritative mode of knowledge production in China to those outside the professional sphere. Popularizers were engaged in defining what constituted common scientific knowledge, but this was not a neutral category. It was closely related to the agenda of popularizers and to their intended audiences. Government projects for disseminating science viewed common scientific knowledge as knowledge that would transform people into citizens. In *Kexue huabao*, in contrast, the basis of scientific knowledge that readers needed was seen as universal. Editorial policies shaped the kinds of interactions that readers had with the journal and with each other, making *Kexue huabao* an important space for non-professional science enthusiasts.

The project of making science popular in China has implications for how we understand the global spread of science. Popularizers in China mobilized the idea of science's universality to navigate their place in an increasingly international world of science. Furthermore, they put into motion a network that circulated words, images, and objects from North America and Europe to readers across Asia. In this way, they contributed to the creation of a globally shared vocabulary of modern science.

Chapter One: "The World of Science at Your Doorstep": Universal Science in *Kexue huabao*

Introduction

"Scientize! scientize! this call, and the call 'science for national salvation' have spread throughout the entire nation and become extremely fashionable slogans! But what do we ultimately mean by scientization?"[69] This question was posed by Cao Huiqun 曹惠群 (1885-1957), a science educator and member of the editorial board of *Kexue huabao* ("Science Pictorial" 科學畫報).[70] In this 1933 editorial, entitled "What is Scientization?," Cao explained that importing the newest scientific inventions from foreign countries, or making copies of them, was not scientization. Rather, it was akin to "scratching an itch from outside the boot" (*gexue saoyang* 隔靴搔癢), a metaphor for failing to address the root of the problem. Scientization, he wrote, meant understanding and implementing a "scientific spirit" (*kexue jingshen* 科學精神) and using the scientific method (*kexue fangfa* 科學方法). Only when all Chinese citizens understand these concepts, China will be able to use science to become a prosperous and strong nation.

Cao's discussion illuminates the tensions that science advocates in China faced. They had to articulate a Chinese science while negotiating its foreign connotations and origins. The term science itself was still relatively new, its scope and meaning still debated even in academic circles.[71] "Scientizing" entailed making a choice of how to use foreign inventions and technologies

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[69] Cao Huiqun 曹惠群, "Shenme jiao kexue hua" 什麼叫科學化 [What is Scientization], *Kexue huabao* 1 no.2, 1933, 1.

[70] The direct translation of the journal's Chinese title, *Kexue huabao* 科學畫報, is *Science Pictorial*. However, like many journals at the time, the magazine had an English title on the cover which was *Popular Science*. I have chosen to use the Chinese title throughout the dissertation to highlight how the neologism *kexue* (science 科學) was imbued with meaning for Chinese readers.

[71] The most well known of the academic debates about science was the 1920s "debate between science and the philosophy of life." For a discussion of the different positions, see D.W.Y. Kwok, *Scientism in Chinese Thought 1900-1950* (New Haven: Yale University Press, 1965), 140 – 157.

while negotiating the boundaries of what counted as Chinese science. It required those involved in popularization to take a stand on the nature of science – was it a uniquely Western invention and practice, and if so, how could it be made Chinese? Or was it a universal method, applicable anywhere? If science was universal, what was the purpose of creating Chinese science?

The claim of science to universality is one of the foundational narratives of the history of science as an academic field, but it also served to promote the idea of modern science as a Western invention. The discipline's pioneers sought a globally unifying narrative to describe how modern science developed and spread. George Sarton, the founder of the journal *Isis*, believed that the search for knowledge was a human trait transcending national or ethnic boundaries, and that tracing the history of science would prove the unity of knowledge.[72] Joseph Needham's research on science in Imperial China was also grounded in the view that modern science was universal. He construed the knowledge systems of different civilizations as rivers flowing into "the sea of modern science," a teleological narrative despite the space it afforded non-Western learned traditions.[73] But the universality these historians articulated was nevertheless Eurocentric and equated modern science with the West. After surveying the history of Chinese science, Needham still held the Scientific Revolution as the yard stick against which scientific development should be measured. His research was motivated by what came to be known as "the Needham Question:" given China's past achievements in technology and science, why did it "fail" to develop modern science?[74] These scholars were willing to recognize that societies outside Europe had histories of science, but modern science was – to them – produced in the West.

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[72] George Sarton, "The New Humanism," *Isis* 6 no.1 (1924): 24, 31-32.
[73] Joseph Needham, *The Grand Titration: Science and Society in East and West*, New York and London: Routledge, 2013 (originally published 1969), pg. 16.
[74] Joseph Needham, *The Grand Titration*, 190. For critiques of this question, see Nathan Sivin, "Why the Scientific Revolution Did Not Take Place in China – Or didn't it?", *Chinese Science* vol. 5, 1982: 51-52.

More recently, science historians have challenged the narrative that modern science emerged exclusively in the West in two significant ways. First, studies on encounters between Europeans and their interlocuters in East and South Asia have demonstrated that elites in colonial settings were active participants in shaping the kinds of knowledge these encounters produced.[75] Second, the very notion of a monolithic and uncontested Western science has come under scrutiny. In the 19th and early 20th centuries, the disciplines we recognize today as comprising modern science were constructed through interactions in colonial settings.[76] Using the examples of Egypt and China, Marwa Elshakry has argued that the very notion of a unified, Western science, was a product of elites in these places negotiating foreign knowledge, local knowledge, and modernity.[77]

The category of universal science was central to the ways Chinese popularizers articulated the notion of scientizing both to themselves and to readers. The editors of *Kexue huabao* made science appealing to readers through a promise to weave them into an imagined global community of popular science readers. They did this by creating a journal that drew from foreign sources for images, news items, and articles, and adapting them in ways that suggested the universality of scientific knowledge. Second, it allowed the writers and editors – many of them professional researchers – to be full participants in producing scientific knowledge, rather than "late adopters". At the same time, patriotic sentiment and an understanding of the importance of internationally

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[75] Fa-ti Fan, *British Naturalists in Qing China: Science, Empire and Cultural Encounter* (Cambridge, MA: Harvard University Press, 2003), ch.1; Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650–1900* (London: Palgrave Macmillan, 2006), 12-20.

[76] Ruth Rogaski, *Hygienic Modernity: Meanings of Health and Disease in Treaty-Port China* (Berkeley: University of California Press, 2004), 6-7; Catherine Jami argues this about mathematics in the 18th century as well. See Catherine Jami, *The Emperor's New Mathematics: Western Learning and Imperial Authority During the Kangxi Reign 1662-1722* (Oxford: Oxford University Press, 2012), 3-6.

[77] Marwa Elshakry, "When Science Became Western: Historiographical Reflections," *Isis* 101, no. 1 (2010): 104–107.

legible science institutions to China's standing on a global stage made defining Chinese science an important endeavor.

The tension between viewing science as a universal methodology, a Western invention, and a way to strengthen the nation, was present not only in articles, but also in the visual and material elements of the journal. The editor's choice of images and covers, the changing linguistic format, and the journal's circulation and readership all indicate a complex commitment to both localizing foreign knowledge and presenting science as universal. To understand the journal's position, we must situate it in the context of its publisher and editors' social topography, and in relation to other popular science publications.[78] The publisher and editors presented to their readers a vision of scientizing China that was different from government sponsored science popularization projects, where science was tied to nation building.

Kexue huabao was published from 1933 to 1952 in Shanghai by the China Science Society (Zhongguo kexue she 中國科學社), an organization comprised of scientists, intellectuals, and educators who were trained abroad, mostly in the United States. It continued being printed after the establishment of the People's Republic of China in 1949, but at the end of 1952 the original editorial board was dispersed, and the magazine was transferred to a new editorial board. Among the dozen or so magazines dedicated to popularizing science in the 1930s, *Kexue huabao* stood out both in its circulation numbers of 20,000 copies, and its exceptionally long and uninterrupted print run.[79]

[78] Joan Judge argues that the full meaning of periodicals is best understood by reading them as an entire product, including the non-textual elements, and situating them within a broader print culture. Joan Judge, *Republican Lens: Gender, Visuality, and Experience in Early Chinese Periodical Press* (California: University of California Press) 2015, 45.

[79] The circulation figures fell significantly during the Second Sino-Japanese War, from 1937 to 1945, and recovered to some extent by 1949. Zhang Jian 張劍, *Sai xiansheng zai Zhongguo: Zhongguo kexue she yanjiu* 賽先生中國：

The magazine was also unique because of its sophisticated use of visuals in articulating the publisher's vision of how China would join a global network of scientific journals. The availability of foreign publications and the technological advances in Shanghai's print industry enabled the magazine to introduce its readers to a visual vocabulary consisting of images from around the world. Building on the popularity of pictorials, the publisher chose a title that would entice readers with the promise of copious visuals, which he hoped would appeal to audiences with no prior knowledge of, or interest in, science (Figure 1.1). The publisher expected that a pictorial would be more accessible to audiences such as women, factory workers, and children. Pictorials had been a popular form of media since the early 20th century. They included a wide range of topics, including entertainment news, social commentary, fashion, and new products, and served as "guidebook[s] on the journey to modernity".[80] The publisher's insistence on the pictorial format is evidence of a commitment to a popular market.

To understand the journal's position, we need to understand its social infrastructure and its material attributes – including its audience, circulation, format, and linguistic choices. This chapter focuses on these elements. The chapter first asks how we understand the role of science popularizers in 1930s China vis-à-vis the concept of knowledge circulation. It then examines how the China Science Society, which published the journal, shaped the narratives on science presented in *Kexue huabao* and enabled it to articulate a position independent from the Republican government. Last, the chapter analyzes the journal's circulation network, its readership, and its material aspects: the images, layout, and linguistic format. Through these elements, the chapter

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中國科學社研究 [Mr. Science in China: A Study of the China Science Society] (Shanghai: Shanghai Scientific and Technical Publishes, 2018), 543; Gedi tongye ge daixiaochu jun jian 各地同業個代銷處均鑒 [Notice to Retailers], *Kexue huabao* 1 no.2, 1933, 39; Records of the China Science Society, Shanghai Municipal Archive Q546-1-263.

[80] Paul Pickowitz, Kuiyi Shen, and Yingjin Zhang, "*Liangyou*, Popular Print Media, and Visual Culture in Republican Shanghai," in Pickowitz, Shen, and Zhang, eds. *Liangyou, Kaleidoscopic Modernity and the Shanghai Global Metropolis 1926 – 1945* (Leiden: Brill, 2014), 1.

parses the tensions between presenting science as universal on the one hand, while also negotiating the meaning of Chinese science.

Figure 1.1: Spread from *Kexue huabao* 1 no. 1, 1933.

<u>Science Popularizers and the Metaphor of Circulation</u>

An advertisement for *Kexue huabao* promised its readers to deliver "the entire world – no, the entire universe – of science to your doorstep".[81] This was not just a marketing tool. In the outline for the magazine that the publisher presented to investors, one of the aims of the journal was to introduce readers to the latest developments in science from around the world. The publisher and editors made a conscious choice to use the globe, rather than the nation, as their point of reference. The decision to make *Kexue huabao* the magazine that brings global science to Chinese

[81]Advertisement for *Kexue huabao* in *Jiachang kexue* 家常科學 [*Domestic Science*], Shanghai: China Science Corporation, 1937.

readers was part ideology, part material reality. Both aspects were tied to the social network and educational background of the people involved in the journal.

The magazine contained texts and images from foreign sources which were printed alongside original articles written by professional scientists or science educators. The editors drew from a pool of foreign publications, such as the British *The World of Wonder*; the American *Nature*, *Modern Mechanics*, and *Popular Science*; the French *Science et Monde* and *Je Sais Tout*; and the Japanese *Popular Science*.[82] In his work on the China Science Society, Zhang Jian has estimated that about two thirds of the articles in *Kexue huabao* were edited translations (*bianyi* 編譯).[83] This quantitative estimate reveals the extent to which the journal relied on foreign sources for a steady supply of articles. But it also obscures the labor involved in crafting the articles and the generative elements of edited translations.

Edited translations were not direct, word to word translations. Rather they used the foreign language materials as a starting point and for a supply of information. Edited translations included material from the foreign language article interspersed with the editors/translator's own narrative voice. It was an onerous process, especially since most writers and editors of the magazine were volunteers who held teaching and research positions. However, it was easier than the alternative: generating completely new articles based on professional scientific research. The journal relied on foreign sources to an even greater extent for its supply of images. Using foreign sources was not simply a cut and paste process, but involved adaptation of the original text, translation, and a fair

[82] Records of the China Science Society, Shanghai Municipal Archive Q546-1-263.
[83] Zhang Jian, *sai xiansheng*, 543.

amount of editing. This kind of work was a recognized and respected form of intellectual contribution in late Imperial and early 20th century China.[84]

Viewing *Kexue huabao*'s use of foreign sources as the result of a limiting material reality ignores the social background that shaped the editors' view of science as universal. The cohort of science educators and popularizers that emerged in China in the early 20th century straddled several realms. Many of them were trained in science abroad, mostly in the United States and Europe, but were also fiercely patriotic.[85] They saw themselves as a bridge, bringing modern science to their compatriots. However, while they believed that modern science was a superior system of knowledge that China lacked, their writing on the nature of science demonstrated that they did not prescribe to discourses that claimed that inherent racial difference made non-whites incapable of producing scientific knowledge.[86] They also transgressed the divide between professional science and popular science. Participating in the construction of a popular understanding of what was correct science was not in opposition to demarcating professional boundaries.[87] Even those working as professional scientists in research institutions or universities often contributed to popular venues, whether general interest magazines or popular science publications, and saw it as their mission to disseminate science to the public. Lastly, these scientists had transnational connections and experience in which they acted as representative of the Chinese scientific agenda

[84] Eugenia Lean, *Vernacular Industrialism in China: Local Innovation and Translated Technologies in the Making of a Cosmetics Empire, 1900-1940* (New York: Columbia University Press, 2020), 74-75.
[85] Wang Zuoyue makes this argument specifically for the cohort of students which established the China Science Society. Wang Zuoyue, "Saving China through Science: The Science Society of China, Scientific Nationalism, and Civil Society in Republican China," *Osiris* 17 (2002): 301-302.
[86] Lu Yudao, "Zhongguo zhi kexuehua yundong" 中國之科學化運動 [The Movement to Scientize China], *Kexue huabao* 1936, vol. 3 no.24, pg. 1.
[87] Fan Fa-ti, "The Controversy over Spontaneous Generation in Republican China: Science, Authority, and the Public," in Benjamin Elman and Jing Tsu, eds. *Science and Technology in Modern China 1880s-1940s* (Leiden: Brill, 2014), 216-217.

in international fora.[88] This group of scientists and science educators therefore saw themselves as participants in a transnational arena of knowledge production, and the content of *Kexue huabao* mirrored this position.

Considering these characteristics, how do we explain the position and role of science popularizers in the first half of the 20th century? Scholars have suggested different terminologies to express the agency and intellectual contributions of colonial subjects in generating knowledge with imperial interlocuters. Focusing on South Asian and European actors in 18th century Indian Ocean trade ports, Kapil Raj argues that the acts of mediation of interpreters, scribes, and guides produced new knowledge. He argues that they became a specialized, distinct profession which he termed "knowledge go-betweens."[89] The science popularizers involved in *Kexue huabao* mediated knowledge on two levels: linguistically and across knowledge registers. They produced a journal that allowed readers of Chinese to learn about new scientific developments as well as about basic concepts in the disciplines of modern science, such as biology, chemistry, and geology. Their proximity to the realm of professional science also meant that they mediated expert knowledge to a lay audience.

Another framework scholars employ to understand how knowledge travels and changes, particularly in the context of imperial expansion, is the idea of knowledge circulation, which James Secord explains as treating science as an act of communication.[90] Scholars have nuanced the

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[88] Grace Yen Shen, *Unearthing the Nation: Modern Geology and Nationalism in Republican China*, (Chicago: The University of Chicago Press, 2014), chapter 3.

[89] Kapil Raj, "Mapping Knowledge Go-Betweens in Calcutta, 1720-1880," in Simon Schaffer, Lissa L. Roberts and Kapil Raj, eds. *The Brokered World: Go-betweens and Global Intelligence* (Uppsala: Science History Publications, 2009), 111.

[90] James Secord, "Knowledge in Transit," *Isis* 95 no.4 (2004):656; Kapil, Raj, "Networks of Knowledge, or Spaces of Circulation? The Birth of British Cartography in Colonial South Asia in the Late Eighteenth century", *Global Intellectual History*, 2017. The concept of circulation has also ben criticized for implying a seamless, disembodied smoothness to a process that was often stalled and complex. See Fa-ti Fan, "The Global Turn in the History of Science," *East Asia Science, Technology, and Society: An International Journal* vol. 6 no.2 (2012): 249-258.

framework of knowledge circulation by examining the movement across the globe of specific texts and objects. Historian have demonstrated the active roles of elites outside the West in making scientific knowledge global by translating and mediating it to their audiences.[91] Recently, scholars have also examined the ways knowledge was prohibited from circulating. Trademark laws, for example, were critical in attempts to prevent the circulation of formulas for commercial products.[92]

Building on this framework, I suggest that we can think about the publisher, editors, and writers of *Kexue huabao* as "circulators." The publisher and editors of *Kexue huabao* selected, edited, translated, and adapted images and texts from foreign language sources, putting in motion a print-based circulation that brought a new vocabulary – visual and linguistic – of modern science to their readers in China and across East Asia. Their transnational identities gave them access to the texts and ideas they circulated. Their choice of visuals, and the ways they manipulated and edited images demonstrated the vision of science they wanted to share with their readers. The science popularizers examined here saw themselves as full-fledged participants in the world of science, capable not only of translating foreign knowledge but producing a version of scientific knowledge that was both universal and local. In the sections below, we will follow how not only ideas about science travelled, but the ways in which the magazine circulated them through its covers, format, and other material aspects.

The China Science Society as Infrastructure

Kexue huabao was shaped by the characteristics of the organization which published it, the China Science Society (Zhongguo kexue she 中國科學社). The society was an association for

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[91] Marwa Elshakry, *Reading Darwin in Arabic*, 22.
[92] Eugenia Lean, "Making the Chinese Copycat: Trademarks and Recipes in Early Twentieth-Century Global Science and Capitalism," *Osiris* 33 (2018): 273.

professional scientists that operated from 1914 until it was dissolved in the 1950s. During its decades of operation, it was the largest and most influential professional science association in China. Its board of directors included prominent scientists, with honorary memberships given to influential patrons such as the Republican regime's first minister of education, Cai Yuanpei 蔡元培 (1868-1940), and minister of Commerce and Business Zhang Jian 張謇 (1853-1926). Society members held positions in universities and the print industry, providing their colleagues and fellow members access to funds, scientific materials, and platforms to circulate their ideas. This was a transnational network which extended from universities in the United States and Europe, to the spheres of government, higher education, publishing, and industry in China. It informed the ways that the publisher, editors, and writers of *Kexue huabao* conceptualized the kinds of knowledge they should be disseminating.

The China Science Society was initially founded following a gathering of Chinese students at Cornell University in the summer of 1914. Ren Hongjun 任鴻雋 (1886-1961), one of the founders and leaders of the society from its establishment until its eventual dissolution in 1952, recalled that the idea was suggested during a discussion about what students abroad could do to serve their country as it experienced political upheaval and social flux following the abdication of the Qing dynasty in 1911. Their urgency to act was augmented by the rising political tension on the eve of the First World War.[93] Most students present at the meeting came to the United States to study science, and shared a belief in the power of science to rebuild China into a strong nation.[94] Motivated by concern for their nation and the grim global circumstances, they decided that they

[93] Ren Hongjun, "Zhongguo kexueshe she shi jianshu" 中国科学社社史简述 [A brief history of the China Science Society], *Zhongguo keji shi zazhi* 中國科技史雜誌, no. 1 (1983): 2-13.
[94] Wang Zuoyue, "Saving China," 292.

could contribute by publishing a journal introducing science, a relatively new term in the Chinese language, to Chinese readers. A scientific journal, they thought, was the first step in building a scientific community, and the primary platform through which they could disseminate knowledge.[95] This was not an uncommon route for educated elites in the late Qing and early Republican period. Publishing periodicals presented a way to forge careers outside of political office, stake out political and social agendas, and continue making their voices heard in the public domain.[96] To ensure that the journal would see the light of publication and not die out prematurely, the group decided to establish a joint-stock based society, the China Science Society, that would serve as the framework for the journal.[97] The society published the first issue of *Science* (*Kexue* 科學) in January 1915. Before they were a professional association of scientists, the China Science Society's main goal was to disseminate scientific knowledge by publishing a periodical.

As the society grew and new members joined, the members' sense of its scope and responsibility expanded. In October of 1915, the society reorganized and amended its constitution. The membership structure changed from a joint-stock to a membership fee model, and new categories of honorary membership were added for potential donors and benefactors. The new constitution put in place a board of directors, a sub-division committee, an editorial department, a translation department, a library, and an executive department.[98] The society registered with the

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[95] "Li Yan" 例言 [Introductory Remarks], *Kexue* 科學, 1 no. 1, 1915. This introduction was unattributed, but Wang suggests that it was written by *Kexue* editor Yang Xingfo. Wang, "Saving China," 301.
[96] Robert Culp, *The Power of Print in Modern China: Intellectuals and Industrial Publishing from the End of Empire to Maoist State Socialism* (New York: Columbia University Press, 2019), 3.
[97] Ren Hongjun, "Diyici nianhui shezhang suozuo baogao jielu" 第一次年會社長所作報告 [Address of the President in the Society's First Meeting], 1916, ZKDZ: FZLC 90 – 91.
[98] "Zhongguo Kexueshe zong zhang"中國科學社總章 [Constitution of the China Science Society], October 1915, ZKDZ: FZLC, 28-30.

Beijing Department of Education in 1916 and moved its operations to Nanjing in 1918, following the return of most of its founding members. In 1920, the number of members grew to 503.[99]

The society relied on various sources for funding, including government, private and semi-public.[100] A significant increase to the society's funds came in 1924 when the second installment of the Boxer Indemnity was returned by the U.S government. To disseminate the funds, the Chinese government established the China Foundation for the Promotion of Education and Culture (Zhonghua jiaoyu wenhua jijinhui 中華教育文化基金會), which had nine Chinese and five American representatives serve on its board of trustees.[101] Ren Hongjun lobbied for the funds to be used for science, specifically for research in the natural sciences. Ren argued that the natural sciences were the least developed disciplines in China, but the costliest in terms of the infrastructure they required. Ren appealed to the universal nature of scientific knowledge in furthering his argument. Investing the Boxer Indemnity funds in scientific research, he wrote, would be beneficial not only to China but to the world, since the results of research in the natural sciences can be shared and enjoyed by people anywhere.[102] These efforts came to fruition and the society was awarded a large part of the fund from 1926 until the Second World War.[103] In 1929, Ren Hongjun and Zhao Yuanren 趙元任 (1892-1982), both founding members of the China Science Society, were chosen to be on the board of the foundation that administered the funds.[104]

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[99] "Zhongguo kexue she gaikuang" 中國科學社概況 [Survey of the China Science Society], January 1931, ZKDZ: FZLC, 230.
[100] Wang Zuoyue argues that this combination of funding sources was part of the society position in a "third realm" between being an autonomous body and maintaining ties to the government. Wang, "Saving China through Science", 312-316.
[101] "Remission of the Boxer Indemnity by the United States," *The American Journal of International Law* 19, no. 4 (1925): 778-79.
[102] Ren Hongjun, "Zhongguo kexueshe dui mei kuan yongtu yijian" 中国科学社对美款用途意见 [The China Science Society's suggestion on using the American Boxer Funds], *Shen bao* July 1st, 1924.
[103] Wang, "Saving China through Science," 313.
[104] China Foundation for the Promotion of Education and Culture, List of Board of Director Members 1924 – 1995. http://www.chinafound.org.tw retrieved March 8th, 2019.

Following the establishment of the Republican government in 1927, the society received 400,000 yuan from the state treasury, as well as permanent ownership of the society's building in Nanjing. With these new resources, the society moved its main operations to a building in Shanghai's French Concession, where they opened the Mingfu Library (Mingfu tushuguan 明復圖書館). and the China Science Books and Instruments Corporation (Zhongguo kexue tushu yiqi gongsi 中國科學圖書儀器公司, hereafter China Science Corporation). In 1930, the society had over 1000 members. Its founding members had prominent positions in major universities and in the national research institute, Academia Sinica. Their activities were supported, financially and otherwise, by benefactors and honorary members in government, industry, and education. This network of social and economic support was crucial to the publication and success of *Kexue huabao*.

From Science to Popular Science: Publishing *Kexue huabao*

Initially conceived as a comprehensive journal to disseminate science, *Science* magazine was ultimately caught in a middle ground of being too complex for lay readers and not discipline-specific enough for professional scientists.[105] The journal's stated mission was to disseminate the newest scientific knowledge from abroad to China, as domestic scientific infrastructure was close to non-existent, and to do so in a way that was accessible to non-experts.[106] In its first years of publication, it carried survey articles on different fields of science, articles on the state of science in China and its relevance to social questions, and a few research articles. It used new-style punctuation and was printed horizontally and left to right, which aligned the publication with the New Culture intellectuals who called for a modernization of Chinese language and literature.

[105] Grace Yen Shen, *Unearthing the Nation*, 90.
[106] "Li yan," 1.

However, even the non-research articles were not accessible in their content or language to a general readership outside the circles of university educated elites. This limited appeal was reflected in its circulation, which did not exceed 3000 copies.[107] While the journal was not accessible for a general readership outside of intellectual elites, it also was not specialized enough to be considered a research journal.

Kexue magazine continued to champion the idea of popularization, despite its limited reach. In discussions on the role and meaning of science, editors expressed the opinion that it was the scientist's responsibility to spread science to non-specialists.[108] Science dissemination was a stated goal of the society's constitution. In the 1922 revision of the constitution, several new clauses were added which addressed the society's intentions to be more involved in science in the public sphere. These clauses stipulated holding lectures and exhibitions and publishing materials for non-professional audiences.[109] Despite these intentions, their main publication catered to the cultural and intellectual elite, and public science lectures and exhibitions were not held until the 1930s.

The publication of *Kexue huabao* in 1933 came after several years of debates on how to best reach larger audiences, which took place in board meetings and during the annual meetings of the society. The person who spearheaded these attempts on the board of the society was Yang Xiaoshu 楊孝述 (Yunzhong 允中, 1884-1974), who was appointed in 1929 to be the managing secretary of the China Science Society. Yang was born in Songjiang county, Jiangsu province. He studied mechanical and electric engineering at Cornell University, where he joined the China

[107] Zhang Jian, *Kexue shetuan zai jindai zhongguo de mingyun: yi zhongguo kexueshe wei zhongxin* 科學社團在近代中國的命運：以中國科學社為中心 [The Fate of Science Societies in Modern China: A Study of the China Science Society] (Shandong: Jiaoyu chubanshe, 2005), 242.
[108] Ren Hongjun, "Kexue jingshen lun" 科學精神論 [On the Spirit of Science], *Kexue*, 1916, vol. 2 no. 1.
[109] "Zhongguo kexueshe xiugai zong zhang cao'an" 中国科学社修改总章草案 [Draft of the Revised Constitution of the China Science Society], October 1922. ZKDZ: FZLC, 36.

Science Society upon its establishment in 1914. After returning to China in 1915 with a B.Sc. degree, he made a career in science education. In 1916 he accepted a teaching position at Hehai Vocational Engineering School (Hehai gongcheng zhuanmen xuexiao 河海工程專門學校) in Nanjing, founded by the industrialist and politician Zhang Jian. In 1925, he was appointed president of the school.[110] In 1929 Yang left the school for a full-time position as the managing secretary of the China Science Society. One of his first proposals was to establish an incorporated printing company that would specialize in scientific materials. The China Science Corporation was established in 1929 in Shanghai with Yang as its managing director. The company printed and published science books and textbooks, and sold supplies to schools and research institutes. This printing infrastructure allowed the China Science Society to publish *Kexue huabao*.

Yang Xiaoshu first came up with a draft proposal for a magazine dedicated to popular science in the spring of 1930, following the China Science Society's annual meeting in Qingdao. He circulated it to the society's board, but could not find investors to fund the initial publication costs, nor a suitable person to act as managing editor.[111] Other society members were also advocating for the need to reach broader audiences. One member wrote a letter in the society's membership bulletin, *The Membership* (Sheyou 社友), lamenting the fact that *Kexue* magazine was not read by "ordinary" people (*putong yiban ren* 普通一般人). Even though the editors tried to make it appeal to general audiences, it still was incomprehensible to lay people. Instead of trying to make *Kexue* magazine serve both professional scientists and lay readers, the reader suggested

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[110] Chen Yutang, ed, *Zhongguo jinxiandai renwu minghao da cidian* 中國近現代人物名號大辭典 [Biographical Dictionary of Modern and Contemporary China] (Zhejiang: Zhejiang guji chubanshe, 1993), 141.
[111] Yang Xiaoshu, "Shi nian huiyi" 十年回憶 [Reflecting Ten Years of Publication], *Kexue huabao* 1943, 10 no.1, 21.

establishing a different journal which would address common people.[112] Yang, who was also the editor of *The Membership*, had an interest in publishing letters from society members that supported his initiatives. He took this letter as an opportunity to reignite the discussion on extending the society's activities to general audiences, and printed his plan for a popular science magazine.

Yang's proposal for a popular science journal underwent several changes, but there were two main tenets which remained constant. The first was that it should be a pictorial, where images and texts would be awarded equal importance (*tuwen bingzhong* 圖文並重). The second was that the publication should contain both "common scientific knowledge" (*kexue changshi* 科學常識), and the latest developments in science from around the world.[113] His initial plan was a publication aimed at students from higher primary school level and up.[114] Yang proposed to publish a sixteen-page weekly magazine, using "new style punctuation", with a color-plate front page that would change weekly. The content would focus on stories, common scientific knowledge, science news, inventions, and would include the newest, most interesting articles written in simple language and accompanied by abundant illustrations. The model for this publication would be the American *Popular Mechanics* and *Popular Engineering*.[115] Yang projected that publishing one issue per week would cost just over 15,000 yuan a year. The main expense would be salaries for a managing editor and two assistant editors, estimated at 140 yuan per month for the editor and 70 yuan monthly for each assistant editor. Printing 10000 copies would cost 145 yuan per month, or just

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112 Qiu Jun 丘峻, "Sheyou tong xun" 社友通訊 [Communications from the Membership], *She you* 社友, February 10, 1931, 2.
113 "Kexue huabao jiang shixian," 科學畫報將實現 [Kexue huabao Becomes Reality], *sheyou* vol. 33, June 20, 1933, 6.
114 Yang Xiaoshu, "Fu tongsu kexue zhoukan fangfa" 附通俗科學周刊方法 [Plan for Popular Science Magazine] *she you* 社友 vol. 6, February 10, 1931, 2.
115 Yang, "tongsu kexue," 2.

under 2000 yuan annually.[116] In this proposal, Yang calculated that by selling 9000 copies for each issue at three *jiao* five *fen*, the publication would break even. This price point was comparable with other popular magazines, which ranged in price from one to four *jiao*.

Two problems prevented the plan from being executed, a lack of investors willing to contribute 150 yuan as start-up funds to cover printing costs, and not finding a suitable editor. Yang had to abandon the plan again, until another opportunity presented itself. This happened in January 1933, in response to a report by society president Zhu Kezhen 竺可楨 (1890-1974) about the central government's plan to launch the "Movement to Scientize China" (Zhongguo kexuehua yundong 中國科學化運動). [117] The campaign aimed to spread new scientific knowledge, but also to "scientize" and systematize Chinese philosophy and cultural heritage and further the social aspects of science. [118] Scientists and educators joined the Association for the Movement to Scientize China (Zhongguo kexuehua yundong xiehui 中國科學化運動協會), which was headed by Chen Lifu 陳立夫 (1900-2001), a high ranking member of the Nationalist party and a conservative.[119] The association had published the first issue of their popular science magazine *Scientific China* (Kexue de zhongguo 科學的中國) that same month.

In response to this, Yang raised a motion to "Develop a Mass Scientization Movement" in a meeting of the society's executive council. As the largest science association in China, he argued, the China Science Society should be at the forefront of spreading science in China and have its

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[116] Yang, "tongsu kexue," 3.
[117] Minutes from the 105th meeting of the executive council, China Science Society. January 7, 1933. Shanghai Municipal Archives Q546-1-65.
[118] "Zhongguo kexuehua yundong xiehui faqi zhiqu shu" 中國科學化運動協會發起旨趣述 [The Objective of the Association of the Movement to Scientize China], *Kexue de Zhongguo* 科學的中國 vol. 1, no. 1, January 1933, 1.
[119] Peng Guanghua 彭光華, "Zhongguo kexue hua yundong de chuangjian, huodong jiqi lishi diwei" 中國科學化運動的創建,活動, 及其歷史地位 [The Establishment, Activities, and Historical Significance of the Movement to Scientize China], *China Historical Materials of Science and Technology* vol. 13. no.1 (1992): 60.

own science popularization initiatives. Yang critiqued the government's initiative for being too text-based and not appealing to ordinary people. Furthermore, it ignored the potential power of images as a medium for science popularization. Yang contended that given the social circumstances, providing "sensory stimulating" scientific knowledge should be the priority, rather than instilling common knowledge.[120] The social circumstances Yang was referring to were not just low levels of literacy. He was also concerned about science being perceived by people as boring and hard to understand. His appeal to sensory stimulation was not solely because of the literacy barrier, but also because new forms of media, such as movies and exhibitions, had the potential to captivate an audience. Using visuals could attract readers from outside the circle of university students, educators, and scientists.

Yang's proposal included three components. The first two, travelling screenings of educational films on science and a popular science pictorial, highlighted using visuals either instead of or alongside texts. The third component was compiling a book series targeted at employees in Popular Education Centers (Minzhong jiaoyu guan 民眾教育館) focusing on agriculture and household science. In this proposal, Yang suggested a more modest version of the journal he imagined. He suggested printing the pictorial in 4000 to 6000 copies as a supplement to *Science* magazine. This way, the society could choose to discontinue it after several issues if it was not successful, or to make it an independent fixture if it proved to be successful.[121] Despite this modified plan's relatively low cost and financial viability, the motion did not carry, and Yang's

[120] Minutes from the 105th meeting of the board of directors, China Science Society. January 7, 1933. Shanghai Municipal Archives Q546-1-65.
[121] Minutes from the 105th meeting of the board of directors, China Science Society. January 7, 1933. Shanghai Municipal Archives Q546-1-65.

attempts to expand the society's science popularization activities failed once again. However, eight months later the first issue of *Kexue huabao* was published, following a fortuitous meeting in June.

In June 1933, Feng Zhizhong 馮執中 (Daren 達人, fl. 1920-1937) came to meet Yang Xiaoshu at the latter's office in the Mingfu Library with an enticing offer: to edit the China Science Society's popular science publication without receiving pay.[122] Feng was a native of Guangdong province, and had studied in France. He had worked at the French-owned International Publishers (Zhongwai shudian 中外書店), where he edited the journal *Science for All* (Kexue zhishi 科學知識, published May 1933 – January 1934).[123] *Science for All* was a science pictorial meant for a wide, non-specialist audience. It featured copious photographs and illustrations alongside short articles on topics such as household science, engineering, and hygiene. In addition to editing the journal, Feng established the Science Information Service (Kexue qingbao chu 科學情報處), a service that would assist companies in obtaining scientific information and expertise required for producing goods.

Feng proposed that he would leave International Publishers to work for the China Science Society. In addition to editing the society's journal, Feng wanted to bring the Science Information Service under the auspices of the society. This offer was a fruitful exchange for both sides. Working for the China Science Society would provide Feng with access to a network of members in research institutes, universities, and industry. Having secured an editor-in-chief with experience in popular science publications, Yang approached the board of Science Corp, which agreed to provide 2000 *yuan* for printing expenses and to print the journal. He then convened a special

[122] Yang, "shi nian huiyi", *Kexue huabao* 1943, vol. 10 no.1, pg. 21.
[123] Similarly to *Kexue huabao*, the journal "Science for All" carried an English name on its cover alongside the Chinese title, Kexue zhishi 科學知識, which is translated as "Scientific Knowledge".

meeting of the board of directors of the China Science Society and presented an amended motion to establish *Kexue huabao*.

The amended proposal was raised as a motion in a special board meeting which took place on June 13th, 1933. In this motion, Yang once again stated the two guiding principles of the publication: that images and texts would be given equal importance, and that the journal would carry the newest scientific knowledge from around the world. The managing editor of the journal, Feng Zhizhong, who was also made a member of the society, would not receive pay for the first year of publication, but would receive a stipend of 500 *yuan* for expenses. There were only two paid positions in the editorial board, one for an administrator and one for an art editor (*meishu bianji* 美術編輯), indicating the journal's commitment to using visuals. Four other members of the society - Xu Kuanfu 徐寬甫, Lu Yudao 盧于道 (1906-1985), Zhou Ren 周任 (1892-1973) and Wang Jiliang 王季梁 (1888-1966) - were named editors, working pro-bono.[124] The Science Information Service was also included in the proposal, making it part of the editorial office of *Kexue huabao*, with Feng serving as its director. The service would liaise with business enterprises in China and abroad, offer consultations, and conduct surveys and cost assessments. In addition, it was responsible for recruiting advertisers for *Kexue huabao*, with 10 percent of the monthly advertising revenue going towards Feng's remuneration and the operation costs of the service.[125]

Popularizing science was not just a patriotic mission. It was a business operation with the potential to become a lucrative career path. Yang's proposals all included a plan to get enough advertisement revenue for the magazine to be economically independent. In the first year of publication, the China Science Corporation provided the journal an advance of 2000 *yuan*, but in

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[124] 108th board of directors meeting minutes, June 13th, 1933. Shanghai Municipal Archives Q546-1-65.
[125] 108th board of directors meeting minutes, June 13th, 1933. Shanghai Municipal Archives Q546-1-65.

subsequent years advertising revenue garnered 2000 to 3000 *yuan* which covered printing costs and salaries.[126]

The journal turned out to be a profitable venture for the society. In addition to advertising revenue, China Science Corporation published a book series under the title "Popular Science Series" (Kexue huabao congshu 科學畫報叢書). The books were collections of articles or columns previously published in *Kexue huabao*. The earliest titles in this series were collected from two regular columns, "General Survey of Entomology" (Kunchong tonglun 昆蟲通論) and "Collected Writings on Plant Diseases" (Zhibing congtan 植病叢談), both published in 1937 and sold for five *jiao*.[127] Later titles included "Medical Entomology" (Yiyong kunchong xue 醫用昆蟲學, published 1938), which was advertised as a guide for understanding the convergence of insects and hygiene, included 300 illustrations, and sold for one *yuan* eight *jiao*.[128] Cheaper, slimmer volumes included "Chemistry Experiments for Youth" (Shaonian huaxue shiyan 少年化學實驗, first edition published in 1939), and "Chemistry Games" (化學遊戲, published 1938), which were targeted at middle school students and elementary school teachers, and cost two *jiao* and eight *jiao*, respectively.[129] Because the books in this series were based on previously published materials, publishing them was only a matter of reprinting, although some included extra materials such as indices. *Kexue huabao* provided an archive that could be mined for specialized publications that

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[126] Zhongguo kexue she di ershiyici nianhui tongji baogao 中國科學社第二十一次年會統計報告 [Financial report for the 21st annual meeting of the China Science Society], 1935, Shanghai Municipal Archive Q546-1-59.
[127] Zhongguo kexue tushu yiqi gongsi tushu mulu 科學圖書儀器公司圖書目錄 [Catalogue of books published by the China Science Corporation], *Kexue huabao*, vol. 4 no.23, 1937.
[128] Advertisement for Yiyong kunchongxue, *Kexue huabao* vol. 7 no.1, 1940.
[129] Zhongguo kexue gongsi faxing mulu 中國科學公司發行目錄 [Catalogue of books published by Science Corp], *Kexue huabao*, vol. 5 no. 18, 1939.

targeted specific audiences and generated further revenue for the China Science Corporation and the China Science Society.

For growing numbers of college graduates and returnee students, science offered a potential employment avenue outside of education, and a chance for developing commercial enterprises. Feng Zhizhong's decision to quit his job as an editor at the relatively small, French-owned International Publishers for the prestigious and domestic China Science Society was not only motivated by patriotism but had sound financial reasoning. Joining the China Science Society gave Feng access to the growing roster of society members in China and abroad, working in industry, education, and government. He could use these connections to build a client base for his own consulting enterprise, the Science Information Service. The publishing world was a way into the business of advising and providing services to a growing local industry. The people involved in *Kexue huabao* were committed to building scientific institutions and communities in China, and saw science popularization as an important part of their social obligation. As individuals, each one of them found a unique way to capitalize on their expertise and on the need for scientific knowledge not only in the printed media but also in industry and government.

The different iterations of Yang's proposal clearly illustrated his approach to science popularization, and how it differed from that of the government sponsored Association for the Movement to Scientize China. Yang believed that reaching a wide audiences entailed not only overcoming the textual barrier, but also igniting an interest in science. Spreading basic scientific knowledge was the goal, but to draw people in to consume the content, the form needed to be appealing. The fact that there was a paid position for an art director indicated the importance of its visual appeal, as well as the principle of "*tu wen bing zhong*" 圖文並重, the equal importance of texts and visuals, which was repeated in the different stages of conceptualizing the journal. Visuals were valued for their aesthetic appeal and for their ability to attract readers. They were also part of the educational mission, as they served to illuminate and explain scientific principles. But the choice of using the pictorial form and the journal's title, *Kexue huabao* (Literally, *Science Pictorial*) was a way of presenting science as a curious, interesting topic. Yang's choice of a title for the magazine aimed to signal to readers that this publication would be entertaining as well as educating.

Science between the Nation and the Universe

Kexue huabao was an international journal in its circulation, scope, and linguistic format. The promise in the journal's advertisement of bringing readers "the universe of science," was a marketing tool and an ideology. A combination of different editorial choices, which included the journal's materiality, visuals, and textual content, produced a publication that was meant to engage with an international sphere of scientific knowledge dissemination. The editors' familiarity with a range of foreign-language popular science publications, and the explicit inspiration they drew from the American *Popular Mechanics*, suggests that they saw *Kexue huabao* not just as the Chinese version of those publications but as an addition to a global repository of popular scientific knowledge. This can also be seen in editorial choices regarding the journal's linguistic format and covers. *Kexue huabao* was meant not only to familiarize its readers with scientific concepts and ideas, but to include them in an "imagined community" of international popular science, in which readers in Shanghai, Singapore, or Kunming needed to have the same knowledge as readers in Germany, Japan or the United States, in addition to knowledge on science in China.

To understand *Kexue huabao*'s narrative on the universality of science, it is useful to compare it with other journals available. The main competitor of *Kexue huabao* was the government-backed *Scientific China* (Kexue de Zhongguo 科學的中國), published by the

Association for the Movement to Scientize China. *Scientific China* featured a photographic image on each cover, but it was not a pictorial – it contained only a small number of visuals, mostly drawn illustrations and very few photographs. The articles were relatively long, ranging from five to ten pages. In contrast, the articles in *Kexue huabao* were typically spread across three to four pages and interspersed with images.

A review of popular science magazines published in *Readers Monthly* (Duzhe yuekan 讀者月刊) in October 1933 commented on the lackluster visual quality of *Scientific China*. The author praised *Kexue huabao* for its use of tasteful, interesting and attractive images, and remarked that *Scientific China* was extremely dull in terms of its layout and visuals, to a degree that was hard to achieve considering the sophistication of the Shanghai print industry.[130] Not only was *Scientific China* less attractive because it had fewer images, its layout resembled higher brow publications, while *Kexue huabao* adopted the pictorial form in its design and layout (see Figure 1). The different columns and sections in *Kexue huabao* were stylized with illustrated motifs that added to the visual experience. Corroborating publisher Yang's impression that general readers might be bored at the mere mention of science, the reviewer Ming wrote that he was expecting articles on science to be tedious, but was surprised by how interesting they were.

Another difference between the approach of the China Science Society and that of the Association for the Movement to Scientize China was in the subject matter of their respective publications. *Scientific China* focused on the connection between science and society in China. It carried articles on domestic natural history, local plant and animal biology, and national

[130] Ming 明, "Jizhong tongsu kexue yuekan" 幾種通俗科學月刊 [A Review of Popular Science Periodicals], *Duzhe yuekan* 讀者月刊, October 1933, 68.

engineering projects. *Kexue huabao* did not eschew "Chinese science", but it contained articles that were much more cosmopolitan in orientation.

Science and Citizenship - the People's Education Centers

The focus on science in relation to the nation was evident in other Republican government knowledge dissemination projects. Education officials linked science to useful, daily knowledge, but in practice the kinds of knowledge presented by these officials to "ordinary people" was used to instill notions of citizenship. This was the case in exhibitions at the People's Education Center (Minzhong jiaoyu guan 民眾教育館) in Nanjing, a government sponsored civic center which operated under the Social Education department in the Ministry of Education. The objective of Social Education was to "increase the people's knowledge" and "equip [them] with common knowledge necessary for life in modern cities or countryside".[131] When the Nanjing People's Education Center opened in 1927, the main criteria that guided the selection of artifacts for the science exhibition was the ability to convey "common scientific knowledge" that was "related to people's lives."[132]

The phrase "common knowledge" was used liberally both in the People's Education Centers and by the publisher of *Kexue huabao.* The term was in widespread use in the 1920s and 1930s, describing various fields of knowledge such as "common hygiene knowledge" (衛生常識), "common scientific knowledge" (科學常識), and "common knowledge of law" (法律常識). Eugenia Lean interprets the term as knowledge that was distinct from high-brow, intellectual, and

[131] Ministry of Education, "Jiaoyubu minzhong jiaoyu huiyi baogao ji you guan wenshu" 教育部民眾教育會議報告及有關文書 [Ministry of Education People's Education Council report and related documents], 1932. Second Historical Archive, 5-2-922.
[132] Jiangsu Provincial People's Education Center, "San nian lai zhi kexue bu" 三年來之科學部 [Three Year Review of the Science Department], *Minzhong jiaoyu yue kan* 民众教育月刊, October 1930, vol. 2 no. 11-12, 1 (Hereafter "Kexue bu").

specialized science. Entrepreneur Chen Diexian 陳蝶仙 (1879-1949) published a column titled "Common Knowledge," which encompassed a wide range of topics, from household tips to manufacturing knowledge and home remedies.[133] In the context of the publishing industry, Robert Culp translates the term as "ordinary knowledge," referring to books on science that were directed at a broad, middle-brow readership.[134]

In the People's Education Centers, common knowledge was similarly used to distinguish knowledge linked to everyday practices from specialized, academic science. It was meant to encode knowledge that was practical and relevant to people's lives, as opposed to the kind of scientific knowledge legible only to specialists. In the writings of Social Education professionals and in *Kexue huabao*, common scientific knowledge was a prescriptive, rather than descriptive, category. It connoted the kinds of knowledge that citizens *should* have, not the kinds of knowledge already widely possessed. This use of the term solidified the boundary between the audience, who lacked knowledge, and the experts who organized exhibitions and published journals.

A closer look at the items that were exhibited in the People's Education Center in Nanjing suggests that rather than provide knowledge that could be implemented in daily life, the exhibits conveyed knowledge that would transform people into citizens. Between 1927 and 1930, the Nanjing People's Education Center added over 2000 items to its science exhibition. 370 items were donated from other institutions and 988 items were purchased. The center also produced 1014 visual aids such as maps, graphs, and charts, as well as 26 specimens and 34 dioramas. The donated items included 114 "national products" (*guo huo* 國貨), which were given to the center for permanent display after a national products exhibition. The center received donations of thirty-six

[133] Eugenia Lean, *Vernacular Industrialism in China*, 133-138.
[134] Robert Culp, *The Power of Print in Modern China*, 156.

German Marks and four Krone notes. The items purchased included 36 plant and animal specimens, laboratory equipment including chemical and apparatus, and 153 items marked "Jiangsu Cultural Heritage."[135]

The 1014 visual aids made by the center emphasized the geo-political categories that formed the nation. For example, there were maps of the different districts in Jiangsu province and a map of the province's rivers, alongside a comparative table of the population in each of China's provinces. A map of the territorial water and land that China lost to foreign powers was a powerful way to reinforce the nation's geography while playing to patriotic sentiment.[136] Other exhibition objects contained information about foreign countries. For example, there was a table of the world's different ethnic groups, a table on the global consumption of cotton, a table on the main imports of different countries, and a comparative table on trade between Japan and China which detailed what each country imported and exported from the other. These exhibition items included knowledge about the world, but it was framed in terms of comparison between different nations.

Some of the visuals and specimens implied a universal interpretation of science, specifically in the categories of physical sciences and biology. In this category, there were pictures of solar and lunar eclipse, a poster explaining the process of rock weathering and a diagram on evolution. There were also posters on the physiology of cats' pupils and dogs' tongues and on the life cycles of the ant. The specimens on display were of organisms that demonstrated abnormality, such as a deformed pig embryo.[137] This group of artifacts was not geographically marked as Chinese. It conveyed an understanding that the information was universal – the pupils of cats

[135] "Kexue bu," 4.
[136] "Kexue bu," 4-11.
[137] "Kexue bu," 4-11.

worldwide responded in the same way to darkness, and the lifecycles of ants in Europe were the same as in China or Africa.

The center claimed that the knowledge it presented was meant to be relevant and useful to the common people. Some of the artifacts, particularly in the health category, were useful. For example, there were posters on treating diarrhea and scarlet fever in children, prevention and treatment for chilblains, and emergency care for morphine, arsenic, and opium poisoning.[138] The exhibition contained a section on agriculture, and at least nominally was supposed to provide information that would be relevant to peasants. But in reality, very few of the exhibition's items had information about farming practices. Rather, the maps, tables, and charts related to agriculture presented quantitative data about agricultural production in Jiangsu province, China, and foreign countries. This was the kind of knowledge that furnished an understanding of the nation, but would not be helpful for peasants in their daily work.

The science department at the Nanjing People's Education Center presented two kinds of claims. First, certain kinds of knowledge were portrayed as universal and strengthened the legitimacy of science as a system of understanding the world. This was a claim that was also made by the writers of *Kexue huabao*. Second, science was a way to derive knowledge about specific local, national, and foreign conditions. This knowledge allowed comparison between political units and was seen as a common base of knowledge for Republican citizens. The knowledge presented to visitors was a politicized version of "common knowledge." Rather than being related to daily life, it lay the foundation for civic consciousness – an understanding that the visitor was part of a political unit which can be known through numbers, maps, or charts. In contrast to *Kexue*

[138] "Kexue bu," 4-11.

huabao, which emphasized the transnational nature of scientific knowledge, Guomindang science popularization initiatives focused on using science to understand the nation and to construct a modern, civic identity.

Universalism and the Materiality of *Kexue huabao*

In the People's Education Centers, knowledge about foreign countries was framed as a comparison. Geert Somsen distinguishes between "Olympic Internationalism," in which the scientific community is seen as an association of nations in competition with one another, and "science universalism."[139] The latter category represents an ideology which views science as a form of knowledge that transcends national boundaries, shared by left-leaning scholars in inter-war Europe.[140] Scientific knowledge from abroad in *Kexue huabao* was not framed as a comparison, implying what China needed to catch-up with. Rather, it was construed as relevant knowledge because science itself was universal, and therefore relevant to any human. But the ideology of universal science existed alongside the reality in which Chinese science often had to prove itself legitimate. This dynamic engendered a tension in portraying science as universal and defining Chinese science, a tension that was reflected in the journal's imagery, circulation, readership, and its linguistic formatting.

Covers

Images were an integral part of how Yang Xiaoshu planned for the magazine to reach the audiences he believed needed science most – children, workers, and women. The covers were important in drawing in these kinds of audiences and portraying science as approachable and

[139] Geert Somsen, "A History of Universalism: Conceptions of the Internationality of Science from the Enlightenment to the Cold War," *Minerva* 46 (2008): 365 – 368.
[140] Somsen, "History of Universalism," 369-370.

interesting. The first cover can be read as a statement not only about the content of the magazine, but also about who the audiences should be. A closer analysis of this image reveals some of the themes that were continuously debated in editorials and articles. The covers chosen throughout the first year of publication mirror the editorial agenda and demonstrate how *Kexue huabao* distinguished itself from other publications. Most of the covers from the first issue of *Kexue huabao*, published between August 1933 and August 1934, were based on images that appeared in foreign popular science journals. The images were sometimes altered in color scheme or in size, but other than the first issue no other covers were "localized". Rather, throughout the first year of publication the covers featured foreign, sometimes imaginary, or futuristic, scenes.

The first cover was a full color illustration, adapted from the cover of a British serial publication titled *The World of Wonder: 10,000 Things Every Child Should Know*. The publication was directed at children, and although it was published weekly, it was intended to be an encyclopedic repository of useful scientific knowledge, rather than a journal. Charles Ray, the editor, wrote in the introduction to the first issue: "It has been so planned that by means of simple description and explanatory drawing it makes clear a vast variety of things that might otherwise seem too difficult to understand. It explains the why and whereof of such familiar phenomena as the thunderstorm, the rainbow, the daily tides at the seaside... and a thousand other things that are known to all but understood by few".[141] The focus of *The World of Wonder* was not the newest scientific inventions and novelties. Instead, it aimed to provide basic scientific knowledge.

[141] *The World of Wonder* was edited by Charles Ray and published in London by The Amalgamated press. The first volume was published in 52 weekly installments from November 1932 to October 1933 and a second volume published from October 1932 to October 1933. It was not a periodical, but an encyclopedic volume published serially. Readers were encouraged to compile the issues into a single volume and a leather binder was available for purchase from the press.

The World of Wonder used illustrations made by L.G Goodwin to accompany their articles. These "explanatory drawing[s]"[142] illustrated the underlying mechanisms of the phenomena discussed, and according to editor Ray, made "the most intricate operations and activities of man and nature…clear and understandable".[143] The editors of *Kexue huabao* frequently used images from *The World of Wonder* to illustrate their articles and occasionally as cover images. The illustrations were often modified or adjusted, mostly by adding Chinese annotations to the images, but sometimes more substantial changes were made.

The cover for the first issue of *Kexue huabao* (Figure 1.2) was based on the cover of *The World of Wonder* (Figure 1.3), but it was altered in significant ways. The artistic director of *Kexue huabao* changed the illustration to reflect a localized version, with details that would look more familiar to Chinese readers and appeal to them.[144] The rays of sun in the original illustration were removed from the *Kexue huabao* cover, probably because they resembled the Japanese Imperial Army flag. As the city was still recovering from the three-month Japanese bombing on Shanghai in early 1932, invoking the aggressor army's flag would not be seen favorably by potential readers.

The cover of *Kexue huabao* emphasized symbols of novelty and modernity. The cover of *The World of Wonder* contained the Tower of London, a direct reference to British history, and an indication of the time-encompassing, and thus encyclopedic, nature of the publication. However, it was removed in the Chinese cover and replaced by two smoking chimneys, invoking modern industrialism. A warship, a zeppelin, a plane, a factory, a train, and a car were the man-made, technological elements in the image. The natural world was represented by a bird, an elephant, and

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[142] Charles Ray, "Introduction", *The World of Wonder* vol. 1, 1932, London: The Amalgamated Press.
[143] Ray, "introduction."
[144] Despite the central place of images, the artistic director was not credited by name in the journal, nor does his name appear in the list of editors in the records of the editorial board.

a giraffe. This cover conveyed *Kexue huabao*'s emphasis on the newest developments in science, and on knowledge that is foreign and exotic.

Figure 1.2: Cover, *Kexue huabao*, vol. 1 no. 1, 1933. Figure 1.3: Cover, *The World of Wonder* vol. 46, 1932.

Small but significant alterations were made to the appearance of the two figures at the image's center, to make them immediately recognizable as Chinese children. Specifically, their hairstyles and clothing indicated that these were urban, Republican, and Chinese children. Both children's hair was changed to a shiny black, as opposed to the lighter hair color of the children on the British magazine's cover. The girl's hair was cut in a bob, the preferred hairstyle for girls in women in the 1930s.[145] The boy depicted on the cover of *Kexue huabao* was wearing a sailor-suit shirt and short pants, a style that was popularized in Victorian Britain and became a symbol

[145] Antonia Finnane, *Changing Clothes in China: Fashion, History, Nation* (New York: Columbia University Press, 2008), 160.

of modernity for young boys in Republican China.[146] The children's stance was not altered. The boy was depicted standing with his back to the viewer, arms stretched out over his head. This position suggests the boy's command over the scene in front of him, a portrayal reminiscent of colonial explorers surveying new lands. The girl's position, seated next to the boy with an open book in her lap, was also not changed. While the girl's hand is turning a page, her head is raised. Similar to the boy, she is also surveying the scene, but her position is much less powerful and does not suggest domination over the landscape. While girls were welcome (and expected) to engage in absorbing scientific knowledge, both in China as in Britain, they were relegated to more passive roles of observing and reading rather than actively participating.

The covers of *Kexue huabao* positioned it as a modern, globally orientated magazine. Its first cover suggested a focus on content that was technologically novel, such as the zeppelin and car, and of foreign origin, such as the giraffe and elephant. Its claim to modernity was reinforced by depicting the children in modern, urban attire. This continued in subsequent covers in the first year of publication and beyond. In the first year of publication, only three of 24 covers depicted scenes from China. 12 contained photographs or illustrations of subjects that were clearly foreign including people, but also technologies, such as the newest Boeing aircraft, an imposing-looking aircraft carrier photographed from the bottom of the bow, and a bridge in Florida. Others depicted scenes such as the Northern Lights and a temple in Egypt. The cover of issue ten, published in December 1933, featured a collage of three photographs of Italian engineer and inventor, Guglielmo Marconi. One picture was of Marconi and his wife visiting a wireless radio exhibition in the United States, the second was of Marconi aboard his yacht, and the third was of the new short-wave receiving antenna recently installed in the Vatican. The photographs were

[146] Valery Garrett, *Chinese Dress: From the Qing Dynasty to the Present* (Vermont: Tuttle Publishing, 2012), 411.

accompanied by explanations that highlighted the novel nature of the communication systems depicted.[147]

Certain covers had explicitly foreign subjects, while others were not marked as local or foreign. In the first volume, four covers depicted such subjects – an illustration of a rhinoceros, an ape, a spider web, and an X-ray photograph of a fetus.[148] In these covers, the subject was removed from its surroundings. The animals (the ape, rhinoceros, and spider-web) were presented as specimens against a blank background, not in a natural habitat that would suggest a particular locality. In the same way, the X-ray photograph did not indicate where it was from, instead suggesting a "universal" fetus.

The cover of volume 11, 1934, purposefully removed visual markers of a foreign location to create a non-marked, futuristic scene. The cover had an illustration of a tall building with a spiraling ramp around it, with the title "The Futuristic World Tower" (weilai de shijie gaota 未来的世界高塔, Figure 1.4). The cover image was a reproduction of a cover from the American *Everyday Science and Mechanics* from August 1933. The tower on the cover was the "Phare du Monde", an observation tower proposed for the 1937 Paris World Fair that was never executed. The original image, as it appeared on the cover of *Everyday Science*, included the Eiffel tower in the background, placing this planned but never executed tower in a specific, European context. But in *Kexue huabao* the Eiffel tower was removed to create a vision of a universal future. These types of covers correlated with the narrative of science as universal, a method of inquiry and way of thinking that does not belong to a particular geographic site or owned by a specific nation, and one that was supposed to contribute to all of humanity.

[147] Cover, *Kexue huabao* 1 no.10, 1933.
[148] Cover images from volume 1, issues 2, 4, 13, 10, 1933 – 1934.

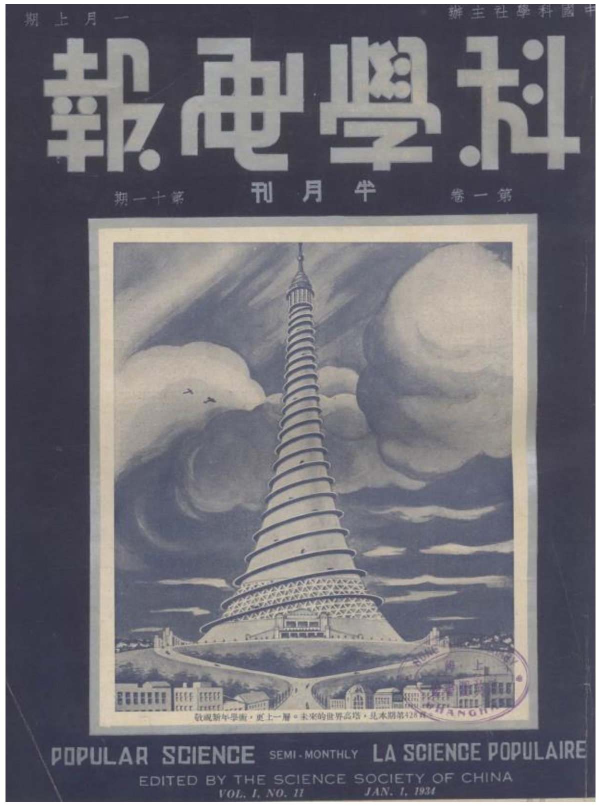

Figure1.4: Cover, *Kexue huabao* vol. 1 no. 11, 1934.

The covers of *Kexue huabao* distinguished it from other popular science publications and were diametrically opposed to the covers of its competitor, *Scientific China*. The first issue of the magazine, published in January 1933, featured a photograph of the Great Wall on its cover. Throughout its print run, from 1933 to 1937, all the covers of *Scientific China* were photographs taken across China. The covers featured famous historical places such as sacred mountains and the Great Wall; modern monuments such as the Sun Yatsen memorial; natural scenery in provinces such as Yunnan and Sichuan; and engineering achievements such as roads and bridges. The consistent use of domestic scenes on the cover of this magazine indicated that its focus was on local knowledge. Presented side by side to a potential reader, the two publications conveyed different ideas on science.

Cost, circulation, and Readership

When it was published in August 1933, the price of *Kexue huabao* was two *jiao*. In comparison with other journals, it was in the mid-range of pricing. *Scientific China* cost one *jiao*, but it did not feature as many images as *Kexue huabao* and its covers were not color plates. The competing *Science for All* (*Kexue zhishi* 科學知識) cost two *jiao* five *fen*, and had a pictorial layout with abundant images similar to *Kexue huabao*. In comparison, the popular pictorial *The Young Companion* (*Liangyou* 良友), which contained more photos than *Kexue huabao*, cost four *jiao*. Other non-pictorial, popular magazines, such as *The Ladie's Journal* (*Funü zazhi* 婦女雜誌) and *Dushu Shenghuo* (*Reading Life* 讀書生活) cost two *jiao*. *Kexue huabao* was similarly affordable to a growing middle class of petty-urbanites (*xiao shimin* 小市民), a group composed of literate workers that staffed positions in offices, banks, retail and industry in urban centers.[149]

From readers' letters and from the list of stores carrying the journal, we learn that it had readers beyond Shanghai, and beyond mainland China. By the end of its first year of publication, the journal had thirty official vendors in cities across China, as well as in Singapore and Thailand. In Shanghai, it was available not only from bookstores, but could also be found in the People's Education center (Minzhong Jiaoyu guan 民眾教育館) and in the China Science Society's Mingfu Library. Beyond Shanghai, the journal was sold and read in almost every large city, including Beijing, Tianjin, Guangzhou, and Changsha. It travelled along the Eastern coast to cities in Fujian and Guangzhou, as well as Hainan Island. There were readers in Kunming, the capital city of Yunnan province in the south-west and in Baotou city in Inner Mongolia. Beyond China, it was

[149] Wen-hsin Yeh, *Shanghai Splendor: Economic Sentiments and the Making of Modern China 1843 – 1949* (Berkeley: University of California Press, 2007), 102.

read in Hong Kong, Macau, Vietnam, Myanmar, Indonesia and Malaysia.[150] It was sold by a branch of Shanghai Bookstore (Shanghai shudian 上海書店) in Singapore, by a branch of Xinhua Bookstore (Xinhua shudian 新華書店) in Bangkok, and in Sumatra.[151] The journal catered to readers of Chinese across the mainland and outside of it, and the dual focus on content from China as well as from around the globe made it relevant to any reader who wanted to increase their knowledge of science, regardless of geographic location.

Chinese students in Europe and North America also read the journal. The China Science Society had a branch in the United States, which had been re-established in 1930. Yang Xiaoshu sent out letters to 40 society members in the United States, asking them to help recruit other overseas students to join the society. In the following year, the American branch of the society included several hundred members.[152] These members could purchase the journal through their representative, who would place the order directly with the society's head office in Shanghai.

Kexue huabao had a Letters to the Editor column, which was printed in the last pages of each issue. The column ran from the second issue in August 1933. It was temporarily suspended in 1939 due to problems in communication caused by the Sino-Japanese war, but resumed after the war ended. The decision to publish readers' letters suggests that the editors wanted to establish a community of readers, and were open to a certain degree of dialogue. In the first issues, they

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[150] This information comes from the readers' letters published in a regular column. Some examples are in: "Xinxiang" 信箱 [Letterbox], *Kexue huabao* 1 no.2, 1933, 39; "Xinxiang" 信箱 [Letterbox], *Kexue huabao* 1 no. 7, 1933, 277; "Duzhe Xinxiang" 讀者信箱 [Readers' Letterbox], *Kexue huabao* 2 no.5, 1934, 200; "Duzhe Xinxiang" 讀者信箱 [Readers' Letterbox], *Kexue huabao* 2 no.7, 1934, 280; "Duzhe Xinxiang" 讀者信箱 [Readers' Letterbox], *Kexue huabao* 2 no. 8, 1934, 320.

[151] Benbao gebu fenxiao chu 本報各埠分銷處 [Distributors of the magazine in different cities], *Kexue huabao* 1 no. 17, 1934.

[152] Wang Zuoyue, "Zhongguo kexueshe meiguo fenshe lishi yanjiu" 中国科学社美国分社历史研究 (The American Branch of the Science Society of China: A Historical Study), *Ziran Bianzhengfa Tongxun* 自然辨证法通讯 vol. 38 no.3 (2016): 5.

solicited feedback by publishing specific questions for readers to answer. Some were related to the content, such as what the readers considered to be the most useful articles, what were the most urgent questions on science they had, and what were the journal's main faults. Other questions related to the circulation of the journal, and inquired where the reader had purchased the journal, if they lent it to friends or classmates, and if they planned on purchasing a subscription.[153]

The "Readers' Letters" column was far from a completely neutral arena for readers to express their opinions. Throughout the first issues of the magazine's first year of publication, it served as a platform for the editors to communicate their plans for the journal, demonstrate the kinds of readers they sought, and to further explain and develop their editorial agenda and mission. In the second and third issues, the editors did not print individual letters, but printed responses to recurring questions. They also used the column to announce the kinds of articles that would appear in future issues, and their plans for holding a scientific invention competition.[154]

In other instances, the editors used the reader's correspondence to reiterate the journal's agenda and intended audience. In the fourth issue, published in September 1933, a letter from a reader named Gao Rui'an 高瑞菴 from Zhoujiakou county in eastern Henan province was printed in its entirety and included a lengthy response from the publisher, Yang Xiaoshu.[155] Gao believed that knowledge of mechanics was the most useful of all sciences, and suggested that the publisher start another journal dedicated to engineering and mechanics. Yang responded by saying that while he agreed there should be publications dedicated to individual branches of science, the mission of

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[153] "Zhengqiu ben kan duzhe de yijian he piping"徵求本刊讀者的意見和批評 [Seeking Readers' Opinions and Critiques], *Kexue huabao,* 1 no.3, 1933, 117.
[154] Cao Huiqun, "Jing fu benkan di yi qi duzhe lai han" 敬復本刊第一期讀者來函 [Replying to readers' letters from the first issue], *Kexue huabao* 1 no.2, 1933, 39.
[155] "Henan Gao Rui'an jun lai han" 河南高瑞菴君來函 [Letter Received from Gao Rui'an of Henan], *Kexue huabao* 1 no.4, 1933, 156.

Kexue huabao was to encourage ordinary people and youth to take an interest in science in general, and not to favor one discipline. Therefore, the editors chose materials that would "inspire scientific thought" (*qifa kexue sixiang* 啟發科學思想） and "stimulate a positive feeling towards science" (*ciji kexue qinggan* 刺激科學情感). He ended the response by saying that the progress of the entire nation depended not on a select few having specialized knowledge, but on the entire population possessing basic scientific knowledge. Yang's response signaled that the journal's approach to the project of scientizing China was one which favored reaching larger audiences with less specialized knowledge. The journal was not meant for specialists, and its intended audience was those who did not have an existing interest, or prior knowledge, in science.

Other letters printed in the first months of publication served to highlight the intended audience that the publisher was aiming at. In the fifth issue, one letter was from Wang Yiming 汪一鳴 of Nanjing, a man who studied law and politics and worked as a proof-reader.[156] He wrote that he enjoyed reading the journal, and when he brought it home, his semi-literate wife (*cu shi ziyi* 粗識字義), his middle-school attending son, and his daughter who was in her last year of primary school, all raced to read it. Wang found the articles illuminating, but did not understand everything, because he did not study science.[157] His question to the editors was about how a propeller works, and he requested they also provide an illustration. This letter demonstrated precisely the kind of readers Yang Xiaoshu envisioned for the journal: urban, educated, men who had no specialized knowledge in science, and their wives and children. A similar type of letter came from a fourteen-year-old boy named Jiang Wei 蔣煒 from Hankou. Jiang wrote to describe

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[156] "Nanjing Wang Yiming jun lai han" 南京汪一鳴來函 [Letter from Wang Yiming of Nanjing], *Kexue huabao* 1 no.5, 1933, 197.
[157] "Nanjing Wang Yiming," 197.

his idea for a bicycle with three gears, after seeing bicycles that had only one gear. He asked if his idea counted as a "scientific invention", and if he could submit it to the magazine's contest.[158]

It is not clear if the letters in these first issues were real or not, considering how well they served to demonstrate the kinds of readers, and questions, that the editors hoped for. However, they were published alongside more substantive questions relating to science, such as what the chemical notation for Radon gas was, or why China did not produce car and airplane motors.[159] The editors may have inserted a few of their own letters to make a point, but other letters do not arouse the suspicion that they were fabricated. It is almost impossible to corroborate the true identities of most readers who sent in letter, as many of them did not leave any traces in the written and published record. Nevertheless, the letters published in the column indicate the types of readers the journal hoped to engage – young boys and girls, their parents, and others with little prior knowledge of science.

After the first few months, the column changed. More letters were printed, but they were usually truncated, and only the relevant section containing the question was published. The publisher sent the letters to other editors or writers who had expertise in the specific field of knowledge. With the increase in readers' letters, the column changed to become a platform for providing expert advice and answers. Readers sought clarification on published articles, asked for suggested reading on specific topics, or posed questions on matters which had scientific explanations. Some questions revealed that the letters' writer had a background in science, while others suggested a general interest in science but no professional knowledge, such as one from a

[158] "Hankou Jiang Wei jun lai han" 漢口蔣煒君來函 [Letter from Jiang Wei of Nanjing], *Kexue huabao* 1 no. 6, 1933, 237.
[159] "Xinxiang Zou Shimin jun lai han" 新鄉鄒石民君來函 [Letter from Zou Shimin of Xinxiang], *Kexue huabao* 1 no.6, 1933, 238.

reader asking whether the speed of light was faster than the speed of nerve transmissions in the body.[160] There were recurring questions about making radio receivers and about soap production.[161] Some readers identified themselves with their job title, indicating the range of readers the magazine had. For example, a bank employee from Chongqing asked for reading material on how to pan for gold.[162] A railway station worker asked a series of questions on the reasons for hair loss.[163] A soldier in the anti-Communist troops asked whether it was possible to mine for magnets using a metal axe.[164] There were also letters from workers in factories, arsenals, and mining companies.

Science for Women

It was rare that women readers wrote letters to the editor. One reader, Zhang Xiuying 張秀英, wrote asking for a method to prepare green ink.[165] Another, Deng Wanwen 鄧婉文 from Guangzhou wrote to ask about the human eye and vision.[166] The scant evidence in the "Readers' Letters" column, however, does not mean that women did not read the magazine. Women were an important demographic in the project of scientizing China. The publisher sought to attract women and girls with specialized columns. The primary role assigned to women in the journal was

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[160] "Shanghai He Zhizhong jun lai han" 上海何執中君來函 [Letter from He Zhizhong of Shanghai], *Keuxe huabao* 3 no. 4, 1935, 160.
[161] Shen Zhuangquan jun lai han 莘莊全君來函 [Letter from Shen Zhuangquan], *Kexue huabao* 1 no.10, 1934, 399; Siming Zhuang Zhengong jun lai han 思明莊振恭來函 [Letter from Zhuang Zhengong of Siming], *Kexue huabao* 2 no.1, 1934, 40.
[162] Chongqing Zhongguo yinhang lai han 重慶中國銀行來函 [Letter from Bank of China in Chongqing], *Keuxe huabao* 3 no. 4, 1935, 160.
[163] Shanghai bei huoche zhan Li Zhenye jun 上海北火車站李振業君 [Li Zhenye from Shanghai North railway station], *Keuxe huabao* 4. no. 24, 1937, 1006.
[164] Dian qian jiaofeijun yilv ertuan Liu Beihai 滇黔剿匪軍一旅二團劉北海, *Keuxe huabao* 4. no. 23, 1936, 961.
[165] Zhang Xiuying nüshi lai han 張秀英女士來函 [Letter from Ms. Zhang Xiuying], *Kexue huabao* 2 no.6, 1934, 240.
[166] Guangzhou Deng Wanwen nüshi lai han 廣州鄧婉文女士來函 [Letter from Ms. Deng Wanwen of Guangzhou], *Kexue huabao* 3 no. 13, 1936, 530.

domestic science educators. Women's education in the early twentieth century was conceived of primarily as a way to equip women with the knowledge they needed as citizens and mothers of citizens, and this discourse was echoed in the way science popularizers appealed to women in the 1930s.[167] However, *Kexue huabao* also acknowledged the potential of women to become scientists, and the kinds of knowledge directed at women in the journal diverged from home economics and hygiene.

Kexue huabao sought out female readers by placing advertisements in women's magazines. One advertisement in "Household Weekly" (Jiating xingqi 家庭星期) read: "When a child reads *Kexue huabao* they can become a scientist (*kexue jia* 科學家), When a woman reads *Kexue huabao*, she can become a self-taught science expert (*kexue tong* 科學通)."[168] Another journal edited by Yang Xiaoshu and published by the China Science Corporation entitled *Domestic Science* (Jiachang kexue 家常科學) implied similar roles for women as domestic science educators. The cover of *Domestic Science* featured an illustration of a Republican woman overseeing two children as they read. In the journal's opening remarks, it purported to supply "mother and fathers" with answers to the different questions children have about the world around them. But as the cover suggested, mothers and children were the main audiences.[169]

However, *Kexue huabao* did not restrict women solely to the role of mothers and homemakers. The journal featured articles that positioned women as professionals and active

[167] Joan Judge, "Citizens or Mothers of Citizens? Gender and the Meaning of Modern Chinese Citizenship," in Merle Goldman and Elizabeth J. Perry, eds. *Changing Meanings of Citizenship in Modern China* (Cambridge, MA: Harvard University Press, 2002), 42.
[168] Advertisement for *kexue huabao, Jiating xingqi* 家庭星期 1 no.4, 1935, 9.
[169] Yang Xiaoshu and Hu Zhenyuan, "Fa kan ci" 發刊詞 (Opening Remarks), *Jiachang kexue* vol. 1, 1937, 1. The journal only had 10 issues, published from February to July 1937. Its publication stopped with the start of the Second Sino-Japanese war. In 1939 it was re-printed as a ten-part book series, each volume in which focused on one room in the home.

participants in science. Other than several articles on Marie Curie, perhaps the most well- known female scientist at the time, there was also an article discussing evidence that women could drive cars just as well as men.[170] Another example was a translation of an article written by Alice Milliat, the chairwoman of the International Association for Women's Physical Culture. The article, translated by editor Feng Zhizhong, was meant to disseminate knowledge about the importance of scientific physical culture to all the readers, not just to women.[171] The journal also had two regular female contributors. One of them, Yang Hengcai 楊姮彩 (dates unknown), the daughter of publisher Yang Xiaoshu, wrote about physics, mathematics, and electricity, topics that were considered masculine and not typically associated with science for women.[172]

An editorial written by a writer using the pseudonym Fuli 伏 櫪, "Women and Science," articulated *Kexue huabao*'s dual position on women's role in science. The first part of the article explained why women needed scientific education. The reasons the author gave echoed the gender normative discourse that argued that women needed science because it would allow them to perform their expected roles as mothers and home-makers better, thus ultimately contributing to "strengthening the race".[173] The second part of the article discussed the kinds of knowledge that women needed to have, arguing that they needed to learn Mathematics, Chemistry, and Physics, because these formed the basis for home economics and domestic sciences. However, the last part of the article introduced the possibility of a more active role for women which was not linked to their gendered social roles. In this part, the author acknowledged that women could serve society

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[170]"Kexue yonghu funü kai qiche" 科學擁護婦女開汽車 [Science Embraces Women Drivers], *Kexue huabao* 5 no.6, 1938, 230.
[171] Feng Zhizhong, trans. "Funü yu tiyu" 婦女與體育 [Women and Physical Culture], *Kexue huabao* 1 no.6, 207.
[172] One example is Yang Hengcai, "Dianshi qianshuo" 電視淺說 [Introduction to Television], *Kexue huabao* 5 no.14, 1938, 552-556.
[173] Fuli 伏 櫪, "Funü yu kexue" 婦女與科學 [Women and Science], *Kexue huabao* 10 no.3, 1943, 114.

as scientists as well. If a woman's natural inclination is to study the sciences, she should be free to pursue her interest just as a man would. Women can have great scientific achievements, the author stated, citing the obvious example of Marie Curie, but he also added that this was a rare occurrence. Ultimately, the article concluded by suggesting that most women are content with fulfilling their duties inside the house.[174]

The kinds of information that made up "scientific knowledge for women" in Republican China's magazines was mainly related to health, hygiene, and domestic sciences.[175] A similar approach to the kinds of knowledge women needed was also displayed in the Nanjing People's Education Center. In July 1930, the center launched a "Knowledge Dissemination Week" which was meant to draw in audiences from nearby villages.[176] The science department prepared three exhibitions for this occasion, housed in separate rooms: a natural science exhibition, a children's exhibition, and a women's exhibition. The women's and children's exhibitions contained visual aids such as posters and maps, but also objects such as anatomical models of body parts and dioramas. The natural science exhibition featured plant and animal specimens, ranging from large mammals such as bears and leopards to insects, mice, sea urchin, and coral. The walls had posters on evolution, animal classification, and different types of soil. The exhibition also contained objects, with a focus on communication technologies and electricity – such as a model of a tram, a model of a telegraph, and a battery.[177]

[174] Fuli, "Funü yu kexue," 115.
[175] Huang Xiangfu 黃相輔, "Jujia bibei: funü zazhi zai wusi qian de tongsu kexue qimeng 1915 – 1919," 居家必備婦女雜誌在五四前的通俗科學啟蒙 1915 – 1919 [Domestic Essentials: Popular Science in *The Ladies' Journal* 1915 – 1919], *Zhongyang ynajiu yuan jindai shi yanjiu suo ji kan* no. 100 (2018): 93-95.
[176] "Ben guan shang jiaoyuting de chengwen" 本館上教育廳的呈文 [Petition submitted to the provincial education department], *Minzhong jiaoyu yuekan*, July 1930, vol. 8-9, 2.
[177] "Gezhong chenlie pin shuoming ji tongji" 各種陳列品說明及統計 [Display objects – explanation and statistics], *Minzhong jiaoyu yuekan* 民眾教育月刊 vol. 8-9, July 1933, 17-22.

The women's exhibition focused primarily on reproduction, health, and hygiene. It contained wax models of the female reproductive system and posters advising women on how to best maintain their health in order facilitate easy childbirth. One set of posters demonstrated the correct way to hold a female baby for her pelvis to develop correctly.[178] In the People's Education Center, scientific knowledge for women was limited to their bodies and the gendered roles attached to them, specifically reproduction. Natural sciences were coded as masculine and contained information about the world.

The kinds of knowledge directed at women in *Kexue huabao* was not solely linked to their domestic duties. The journal's second regular female contributor, Lu-Shao Jingrong 盧邵靜容 (fl. 1930-1955), who was married to scientist and writer Lu Yudao 盧于道, wrote over 50 articles for the journal on different topics. From 1936 to 1941, she wrote two regular columns – "Science for Women and Children" (Fu ru kexue du wu 婦孺科學讀物), and "Common Knowledge of Physiology" (Shengli changshi 生理常識). "Science for Women and Children" contained articles that focused on animal and plant biology. According to Lu-Shao women, children, and "the masses" (*dazhong* 大眾) needed to know basic concepts in biology in order to properly understand the world.[179] The column included topics such as patterns of bird migration; the life cycle of ants; the biology and social organization of bees; and the physiology of cats and dogs. Although women were presented mostly as educators, the information itself was not related to their domestic duties.

[178] "Gezhong chenlie pin zhizuo fangan ji shuoming" 各種陳列品製作方案及說明 [Plan of manufacture and explanation of various exhibition items], *Minzhong jiaoyu yuekan* 民眾教育月刊 vol. 8-9, July 1930, 9.
[179] Lu Shao Jingrong, "Fu ru kexue du wu – mayi guo" 婦孺科學讀物 - 螞蟻國 [Science Readings for Women and Children – the Country of Ants], *Kexue huabao* 3 no.10, 1935, 392.

It suggested that women were meant to have s basic scientific understanding of the natural world surrounding them that all citizens should have.

Kexue huabao presented a dual role for women in relation to science. On the one hand, it appealed to the traditional gender roles which focused on women's productive and reproductive labor. "Scientizing" women was a way to modernize these roles without changing or contesting them. But it also offered a more active and substantial role for women, presenting them as potential scientists and veering from the fields of knowledge relating to domestic production and reproduction that were commonly presented as "science for women" in the Republican period.

Language and Format

Alongside the physical circulation of the journal beyond the mainland, the linguistic style and formatting supported the transnational view of science advanced by the publisher and editors. Throughout its publication, *Kexue huabao* used Indo-Arabic numerals, Latin nomenclature, and English terminology for scientific terms, sometimes accompanied by Chinese transliteration. This editorial choice was partly aligned with conventions in other periodicals, specifically in relation to given names of foreigners. It is also indicative of the fact that even in the 1930s scientific terminology was still in a state of flux, and scientists and science educators continued their efforts to create a Chinese-language lexicon for science.

However, these format conventions also signaled something unique to the China Science Society. Producing scientific materials in the Chinese language was a central part of advancing science in China. In the 1910s and 1920s vocational schools, teacher's colleges, and universities emphasized the need to have teaching materials in Chinese instead of relying on foreign language textbooks.[180] During Yang Xiaoshu's tenure as head of the Hehai Vocational School, he commented on the need for Chinese language materials.[181] In this context, *Kexue huabao*'s choices of formatting and use of foreign scripts was also a statement on how they envisioned "scientizing China". Publishing the journal in the Chinese language was a given, but adapting the format and incorporating foreign scripts and number systems was an adjustment required in order for China to fit into the international arena of scientific knowledge communication.

The Latin alphabet was used to provide the Latin names of plant and animal species, and to indicate names not in Chinese. When mentioning foreign scientists, their names were transliterated using Chinese characters alongside Latin letters. For example, in an article on the discovery of radium and radioactivity, the names of Physics Nobel laureates Sir J. J. Thompson and Lord Ernest Rutherford were transliterated, and their English names appeared in brackets after the characters: "湯姆孫 (Sir J. J. Thompson)", "羅撒福 (Lord Rutherford)". In the same article, the author mentioned Marie Curie, using both her Chinese characters, *Juli furen* 居利夫人 and Latin alphabet in brackets – Madame Curie. Curie was already a well-known name for Chinese readers, and they would undoubtedly recognize her Chinese name.[182] The chemical elements radium and uranium, and the terms radio-activity (sic), proton, and nucleus were given in Chinese characters with the English in brackets.[183] While the readers may not have been familiar with

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180 Xiaoping Cong, *Teachers' Schools and the Making of the Modern Chinese Nation-State, 1897–1937* (Vancouver: UBC Press, 2007), 71-87.
181 Yang Xiaoshu 楊孝述, "Fu ri kaocha jiaoyu riji" 赴日考察教育日記 [Account of trip to Japan to investigate education], *Hehai zhoubao* 14 no.9, 1926, 138.
182 Marie Curie's biography was published in several periodicals, such as *Dongfang Zazhi* 東方雜誌 [Eastern Miscellany] and *Funu Zazhi* 婦女雜誌 [Ladies' Journal], as well as in the daily newspaper *Shen bao* 申報. The readers of *Kexue huabao* in 1934 were likely to have already encountered Madame Curie's name. In the article discussed here, the character 里 was replaced with a homonym, 利. This could have been a result of the typesetting, rather than a conscious decision to alter Curie's established Chinese name.
183 Wang Chang 王常, "Lei de faming he fangshe de shenqi" 鐳的發明和放射的神奇 [The Invention of Radium and the Mystery of Radiation], *Kexue huabao* 1 no.24, 1934, 922.

Thompson or Rutherford, they were most likely familiar with Marie Curie. Therefore, the choice to include her name in Latin alphabet was a deliberate signifier of cosmopolitanism. The inclusion of foreign language names, whether of individuals or species, and terms, signaled to readers the global outlook of the journal.

The signaling toward being a globally minded journal was also manifested in the print formatting. In its first volume, *Kexue huabao* was printed vertically from the top-right to the bottom-left, in the traditional format for writing and printing in Chinese. However, since the images were spread across the page, sometimes image annotations were printed vertically and sometimes horizontally (Figure 1.5). According to the editors, the use of vertical writing created problems. Errors in printing were often corrected in the Letters to the Editor section. In October 1933 in a note to readers, the editors blamed printing mistakes which resulted in inaccuracies on the right-to-left, vertical orientation of the text layout. According to them, it did not easily accommodate the use of Arab numerals, punctuation, foreign languages, and mathematical formula, and they announced they would change the journal's print orientation.[184] This was not merely a technical imperative, but a deliberate choice. Other journals at the time were able to print Arab numerals and Latin alphabet in vertical texts. The editors of *Kexue huabao* announced that from the next issue, all image annotations and explanations will be printed vertically but from left to right. The result, from issue seven of the first volume, was two layout systems that existed concurrently on the same page. While the main text of the articles was still arranged vertically, top right to bottom left, the accompanying images and their annotations and explanations, were printed vertically, left to right.

[184] "Ben bao kanwu bing shengming" 本報勘誤并聲明 [Corrections to printing errors and announcement], *Kexue huabao* 1 no.6, 1933, 237.

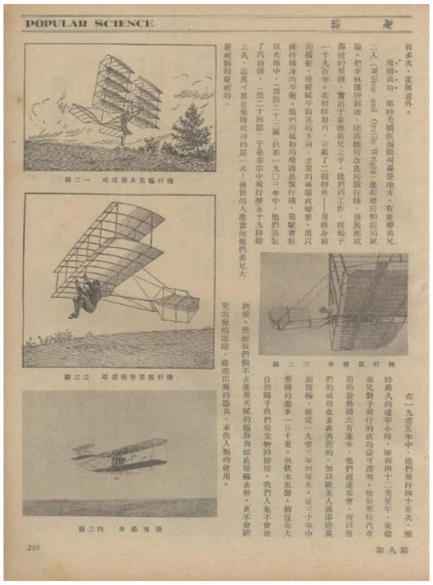

Figure 1.5: vertical format in main text and horizontal format in image annotations. *Kexue huabao* vol. 1 no.9, 1933.

A more drastic change occurred from the second volume published in June 1934. The opening editorial announced that effective from the first issue of the second volume the entire journal would be printed horizontally, left-to-right. The reason again was that it was to better accommodate the use of "Western words and Arabic numerals" into the text.[185] This time they did not claim it was a technical issue but explained that having foreign words and numbers in a vertically aligned text made it difficult to read. Wang Jiliang, who penned the editorial, wrote that this style was successfully implemented in the society's first publication, *Science*, and that the editorial board was convinced that the readers of *Kexue huabao* would not be put off by the new format of the journal. The editorial suggested that this did not constitute Westernization, nor did it contradict an effort to make science more Chinese. The editors saw the use of Latin alphabet and "Western words" as part of a universal scientific labeling to assist in identification, and as a way to participate in global scientific knowledge exchange. Although the editors seemed to perceive

[185] Wang Jiliang, "Ben bao yi nian lai zhi huigu"本報一年來之回顧 [Reviewing one year of publication], *Kexue huabao* 2 no.1, 1934, 1.

Latin as a neutral, "global" scientific language, we can see that the idea of a universal science relied on European language conventions.

Changing the orientation of the journal did not deter readers. Letters from readers that were published throughout the first volume, prior to the change in format, suggest that readers had facility in languages other than Chinese and were interested in, and able to engage with, scientific writing in foreign languages. Several readers wrote to request that articles translated from foreign sources contain the name of the author and publication in the original language, as well as place of publication, to help them track down the reference.[186] In subsequent volumes, readers who sent in letters requesting further reading materials on different topics, specified if they could read other languages, or whether they were looking for reading material in Chinese.

This indicates the variety of educational backgrounds of the readers, and attests to the fact that readers who could only read Chinese continued to be interested and find value in the publication. The use of foreign words did not seem to alienate readers who could not access these texts. Rather, it served to link *Kexue huabao*'s readers to an imagined global sphere of scientific writing, and to make more explicit for readers the network that allowed the writers and editor to publish the journal. Foreign language publications that were available to the staff of the journal might not be available to the readers, due to cost or language barriers. But *Kexue huabao* allowed readers to access this material, using a layout that indicated receptiveness and immersion in a global network of scientific knowledge production. This linguistic adaptation would serve the journal in engaging with foreign language content and sources. In order to bring news of the latest developments in science, the format needed to allow for easier embedding of foreign language

[186] "Xinxiang" 信箱 [Letters to the Editor], *Kexue huabao* 1 no. 2, 1933, 79.

scripts. The editors of *Kexue huabao* did not consider their choices as succumbing to foreign influence or diminishing the mission of appealing to local audiences. However, it is important to note that the adaptation necessary to fit into a transnational "world of science" was one directional. This Chinese publication chose a format that resembled the print orientation of Indo-European languages such as English, French, and German. The choice was done in the name of universal science, but a reverse adaptation – from the European to other linguistic systems – was not required.

Conclusion

The journal *Kexue huabao* demonstrates that the project of "scientizing" China was not confined to discourse on national strengthening, nor dominated by government actors and professional scientists. The journal's approach went against the common conception of what localizing means, and was markedly different from the approach heralded by the Guomindang. *Kexue huabao* shared a similar mission with government sponsored science popularization initiatives, namely disseminating scientific knowledge to ordinary people. But the kinds of scientific knowledge they presented differed. The People's Education Centers used scientific knowledge to promote traditional – if modernized – gender roles and a new civic consciousness. And *Scientific China* focused on science as it related to the nation. In contrast, by casting science as an international endeavor and insisting that readers of Chinese should be informed on new scientific developments from around the world, the journal carved a space for their audiences in the cosmopolitan imagination that characterized large cities in Republican era China.

The social, economic, and institutional context of the journal's publisher, editors, and writers was a key component of this view of science. It was deeply influenced by the social landscape in which the journal was rooted – the scientists and educators which were part of the China Science Society. The international background of the society's members placed them in between the domestic and the foreign, and made them representatives of both worlds. Bringing this background to the fore allows us to better understand the complex position these science educators occupied. They cannot be labeled as mediators because they were actively generating knowledge, either through graduate research, as professional scientists, or as science popularizers. Furthermore, their insistence on science as a transnational project, demonstrates that we cannot simply see them as part of the narrative of science for China's national salvation.

On the pages of *Kexue huabao*, this vision was accomplished not only through texts, but also through visuals drawn from a repository of foreign magazines, and by combining different linguistic systems on the journal's pages. Exploring this materiality and the people behind it makes the somewhat disembodied concept of circulation more concrete and tangible. This in turn enables us to appreciate the generative nature of circulating texts and images, and afford the actors who preformed this work a position of agency. Knowledge did not freely circulate of its own accord, naturally. Tracing how certain images were selected, edited (or not), and reframed brings to light how the wheels of circulation were put in motion, and by whom. Positioning the editors of *Kexue huabao* as "circulators" both embodies and nuances our understanding of the routes through which knowledge traveled. The fact that Chinese readers were made aware of a transnational visual vocabulary of science was due to the ideological commitments and material reality of science popularizers. These actors, therefore, played a significant role in creating a universal version of science.

At the same time, this universalism still carried the undertones of Eurocentrism. The linguistic practices and formatting in *Kexue huabao* reveal an acceptance of Western languages, specifically English and Latin, as the lingua franca of science, and a replacement of Chinese numerals with Indo-Arabic numerals. The editors themselves did not frame this as a capitulation to “Westernization” but accepted it as a necessity of participating in the world of science. But these practices demonstrate the difficulty, and perhaps futility, of the idea of a truly transnational science in which participants from different national, linguistic, and ethnic backgrounds are afforded an equal footing. At the same time, foregrounding the attempts of Yang Xiaoshu and his colleagues in crafting a universal vision of science shows us this was not a uniquely Euro-American discourse, and that actors in China had a stake in representing science as universal.

Chapter Two: Scientizing China, Sinicizing Science

Introduction

In the opening editorial of the second volume of *Kexue huabao*, published in August 1934, Wang Jiliang 王季梁 (1888 – 1966), a chemist who was on the journal's editorial team and an editor of *Kexue* magazine, wrote: "if we wish to 'scientize China' we must also 'Sinicize science'" (Xiang Zhongguo kexuehua ye xu kexue Zhongguo hua 想中國科學化也須科學中國化).[187]

The dual imperative to make China scientific and make science more Chinese signifies the fraught relationship between science, China, and the world. Scientizing meant that science was something China lacked. "Sinicizing science" implied that science was a foreign concept that needed to be adapted locally. The questions of where science originated; how it can be made "Chinese;" and what how to achieve scientific-ness were at the core of the work of science popularizers. In the case of *Kexue huabao*, several narratives emerged in response to these questions.

The different narratives which will be explored throughout this chapter are framed by two conceptualizations of science. The first is the notion that science is a universal way of knowing and that science had the potential to unite people and transcend national boundaries. The second was that science was an important factor in modern nation-building, and that scientific achievements were critical for China's survival. In chapter one, we saw that the idea of science as an international undertaking was a key element in how the members of the China Science Society understood their role. The idea of science as universal was not naïve optimism. Rather, it enabled the journals' writers and editors to contest the claims of science's foreign origin. Presenting science

[187] Wang Jiliang 王季梁, "Ben bao yi nian lai zhi huigu" 本報一年來之回顧 [Reviewing One Year of Publication], *Kexue huabao* 2 no.1, 1934, 1.

as universal allowed them to carve a space for Chinese scientists to participate as equals in producing scientific knowledge. At the same time, *Kexue huabao* also discussed science in relation to the nation, and attempted to define what was Chinese science. This entailed evaluating past understandings of nature in Chinese classics and popular culture, and an assessment of China's current position in the global production of scientific knowledge. The categories of national, global, and universal often coexisted in the magazine, even within one article.

Underlying Wang's two calls to action was a narrative of lack. Science was seen as something external to China and something that China lacked. The idea that China, and the non-Western world in general, was inherently unscientific was of course a common colonial narrative. But it was also expressed by Chinese intellectuals. Feng Youlan 馮友蘭 (1895 – 1990), a prominent philosopher who earned his Ph.D. from Columbia University in 1923, wrote an article explaining that China had no science because its past philosophers were more interested in matters of the mind than in nature.[188] Feng's argument was not a neutral position, since he claimed that lacking science was what held China back in modern times.[189] The work of Joseph Needham, who pioneered the study of the China's history of science, presented ample evidence that China had many systems of knowledge in the past, but nevertheless "failed" to develop modern science. The idea that "China" and "modern science" were two incompatible entities came both from external views and from Chinese intellectuals.

The question of China's relationship to modern science troubled Chinese elites since the mid-19th century, in the wake of the Opium Wars and European and Japanese encroachment on Chinese

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[188] Feng Youlan, "Why China has no Science: An Interpretation of the History and Consequence of Chinese Philosophy," *International Journal of Ethics* 32 no.3, 1922, 259.
[189] Feng, "Why China," 237.

territory.[190] In the mid-19th century, a group of high-level politicians formed the Self-Strengthening Movement, based on the idea that the power of foreign countries came from their technology. They built shipyards and employed foreign experts, translated books on science and technology, all with the aim of getting the most advance technology. The self-strengthening approach was to implement foreign technology while retaining Confucian ideology. Many of the reform-minded intellectuals and politicians involved in the movement did not see foreign knowledge as antithetical to native epistemologies but rather complementary.[191] After the Qing lost in the First Sino-Japanese war of 1895, despite having a stronger navy equipped with the latest military technology, the self-strengthening approach was deemed a failure.[192]

A shift in the relationship between foreign and native knowledge systems happened at the turn of the century. Chinese students returning from abroad marshaled an iconoclastic approach that called to radically alter not only the political system, but Chinese culture and society as well. This movement, called the New Culture Movement, pinned China's political and economic woes on Confucianism, an ideology they believed to be feudal and outdated. To leading figures in this movement, the old culture was seen as a hinderance to modernity. This position was most clearly

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[190] Earlier contact with European knowledge mostly happened through interactions with missionaries that presented different power dynamics. Benjamin Elman suggests that early interactions were characterized by accommodation between European missionaries and literati in the Imperial court. Benjamin Elman, *On Their Own Terms: Science in China, 1550 – 1900* (Cambridge, Massachusetts: Harvard University Press), 2005, xxxi – xxxii. Catherine Jami, on the other hand, has argued that interaction and communication between Jesuit missionaries and the Qing court demonstrate that there was no fixed, monolithic European knowledge nor was there a Chinese one. Catherine Jami, *The Emperor's New Mathematic: Western Learning and Imperial Authority During the Kangxi Reign 1662-1722* (Oxford: Oxford University Press, 2012), 3-5.
[191] Grace Yen Shen, "Scientism in the Twentieth Century," in Jan Kiely, Vincent Goossaert, and John Lagerwey, eds. *Modern Chinese Religion II: 1850 – 2015* (Leiden: Brill, 2015), 97 – 101.
[192] On this perception among Qing intellectuals, see Benjamin Schwartz, *In Search of Wealth and Power: Yen Fu and the West* (Cambridge, Massachusetts: Harvard University Press, 2009 [1964]), 14-19. On the Qing navy see Meng Yue, "Hybrid Science versus Modernity: The Practice of the Jiangnan Arsenal, 1864 – 1897," *East Asian Science, Technology, and Medicine* no. 16 (1999): 13-52.

articulated by Chen Duxiu 陳獨秀 (1879 – 1942) in his article on replacing the old with "Mr. Science" and "Mr. Democracy".[193]

There were other voices among the Chinese intelligentsia who did not believe that science and Westernization were the only way forward. Heated debates on the relative virtues and drawbacks of both Eastern and Western civilizations took place between philosophers, historians, and scientists on the pages of elite journals.[194] These debates reiterated the dichotomy between East and West, eventually placing science on the same side of the binary with the West.[195] Alongside these perspectives were neo-conservatives who did not view science as incompatible with Confucian values, but believed the former could make the latter more suited to modernity. Given these diverse negotiations of the relationship between science, China, and modernity, it would be more accurate to characterize the 1920s and 1930s as a time when the intellectual community was grappling with defining what was Chinese, and how to make it "fit" with the modern world. But behind many of the arguments in these debates was an assumption of a binary of Western and Chinese. This was the cultural climate in which the writers and editors of *Kexue huabao* were taking on the mission of making China scientific, and making science Chinese.

On the pages of *Kexue huabao,* the civilization dichotomy existed while also being blurred. Foreign and Chinese science were presented side by side. Nearly each issue contained articles on Chinese as well as foreign science, and within the articles and columns, developments in foreign countries were linked to what was happening in China, and vice versa – Chinese science was

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[193] Chen Duxiu 陳獨秀, "Ben zhi zui'an zhi dabian shu" 本志罪案之答辯書 [Response to the Accusations against the Journal], *Xin qingnian* 6 no.1, January 1919.

[194] The most well-known of the academic debates about science was the 1923 "debate between science and the philosophy of life." For a discussion of the different positions, see D.W.Y. Kwok, *Scientism in Chinese Thought 1900-1950* (New Haven: Yale University Press, 1965), chapter 6.

[195] Wang Hui, "The Concept of Science in Modern Chinese Thought," *Journal of Modern Chinese History* vol.5 no.1 (2011): 62-63.

compared with foreign. In some cases, reference was made to local systems of knowledge and to older texts which the reader would be familiar with. A large percentage of the content, especially in the main articles and in the "Science News" column, was about scientific discoveries abroad. However, even in these cases, a close inspection reveals that the Chinese authors rarely stuck to direct translations. Rather, they "localized" the material by composing edited translations (*bianyi* 編譯), in which the source material was used as a basis. Longer articles often included the author's own assessment of the technology and a reflection on how it could be utilized domestically. Flipping through the pages of the different issues, both local and foreign science were presented on equal footing, despite the numerical advantage of articles on science from abroad.

Take issue 17 of the first volume, published in April 1934, as an example. The cover – the first thing the reader would see even before they touched the journal – was a photograph of the MIT Van de-Graaf electrostatic generator. The image showed the tall machine in a hanger, with two workers at its base, dwarfed by its size. The generator was used to create high voltage electric charge that was used in experiments, most importantly in attempts to split an atom.[196] After flipping through the first pages of advertisements for science books and equipment and the table of contents, the reader would see the editorial. In this issue, it was a discussion of the meaning of scientific knowledge written by Lu Yudao, one of the editors. The editorials were not illustrated, presenting readers with blocks of texts. The first article was about the Mandarin fish (*guiyu* 鱖魚), the title of which was a couplet from a Tang dynasty (618- 907) poem. The article was accompanied by images of Chinese paintings and anatomical illustrations. The next article was about the phenomenon of solar halo as observed by the author in Xi'an and E'mei mountain in

[196] "Xin chuang yuanzi jipo ji" 新創原子擊破機 [Newly Constructed Atom Splitting Machine], *Kexue huabao* 1 no.17, 1934, cover and pg. 656.

Sichuan province (Xi'an yu E'mei shan zhi riyun 西安與峨眉山之日暈), with a black and white photograph of a solar eclipse. The next article was about the mechanism of a diesel engine, with an illustration adapted from the British *The World of Wonder* and overlayed with Chinese annotations. Perusing the journal, the reader would see a variety of images from China and abroad, and a mix of science that was situated in China or in a foreign country, or geographically unmarked.

This chapter parses the ways that the journal's writers and editors approached the question of where science came from and what constituted Chinese science. I do this by examining three different narratives about the relationship between China, science, and the world. The first, which I term "China-made global science," placed science produced in China or by Chinese scientists on a par with science across the world, and highlighted the contribution of Chinese science not just to the nation but to the world. The second type of narrative, which I call "the un-scientific past," related to traditional Chinese understandings of nature. In *Kexue huabao*, "ancient" knowledge was placed on a global temporal continuum, implying that all of humanity was developing towards modernity. Therefore, the scientific knowledge of the past was not a marker of China being inherently unscientific, but was seen as part of a global past. The third narrative presented modern science as a universal body of knowledge, and therefore one which China had as much claim to as the West. This narrative reinforced the kind of global imagination that underlined the choice of covers and linguistic decisions discussed in the previous chapter. However, I will show that national concerns and patriotic sentiment interfered with and undercut the assertion of science being completely neutral.

China-Made Modern Science

According to Wang Jiliang, to "sinicize science" was to produce knowledge in Chinese about natural phenomena in China. Wang believed this kind of knowledge was more relevant to domestic readers, and would serve the larger purpose of scientizing China. Conducting research based on natural materials and on the geo-body of what was known as "the nation" (*guojia* 國家) would give the readers a way to understand their nation through science, a lens of knowledge the editors of the magazine saw as objective and modern.

In his editorial, Wang highlighted the contributions to the journal from writers in China. The thorough and vivid articles which were continuously being submitted by people who research science in China, Wang wrote, greatly increased the value of the publication.[197] Wang believed that articles written by local writers, both scientists and science educators, were an important indication of the extent to which science was considered important and relevant in Chinese society. Knowledge produced locally was a point of critical importance to Wang in considering how the publication should move forward. He believed that making science more Chinese meant using more Chinese materials. For example, when discussing biology, examples from China's flora and fauna should be used. When writing about physical sciences, writers should utilize local phenomena in geology, geography, industry, and chemistry as the objects of debate. This would provide readers a way to know their own country in scientific terms. The readers' response and writers' enthusiasm, Wang concluded, showed that at least in part, the aim to popularize science was beginning to be achieved. Wang credited the participation of local writers for being a part both of "sinicizing science" and "scientizing China."

[197] Wang, "Ben bao," 1.

Wang's concept of what could be considered "Chinese science" was centered around the national provenance of the object under discussion. In this way, readers could understand their nation through scientific explanation, and gain the vocabulary in Chinese to discuss familiar natural phenomena. Science, therefore, was a method which could be applied to any specific national context. It was a universal way of thinking, that when utilized in a specific national context would produce a "national science".

Zhang Jubo's Entomology Series

What were the uses of this kind of Chinese science in the context of a popular publication? How would Chinese science be of use to local readers? Was the goal of *Kexue huabao* to provide useable information to reader, or was it to frame knowledge about local phenomenon through the lens of modern scientific practices? An article series on insects illustrates the complexity of differentiating between local and foreign science, its utility, and reception by readers. The series, "Collected Writings on Insects" (Kunchong congtan 昆蟲叢談), was written by Zhang Jubo 張巨伯 (1892 – 1951). Zhang was the head of the entomology bureau of Zhejiang province (Zhejiang sheng kunchong ju 浙江省昆蟲局) and a professor in the agriculture department at Jinling University (Jinling daxue 金陵大學, later renamed Nanjing University). A native of Guangdong province, Zhang studied entomology in Ohio State University from 1912 to 1917. In addition to "Collected Writings on Insects", he also wrote an article series entitled "Collected Writings on Plant Diseases" (Zhibing congtan 植病叢談), as well as several more articles on pests. The two "Collected Writings" volumes were published in *Kexue huabao* from 1933 to 1934, and were later published as single volumes by the China Science Society's publishing house, Science Corp.

Zhang's articles embodied Wang Jiliang defined as "Sinicizing science". They were written by a Chinese scientist, they focused on local insects and plants, and were accompanied by photographs and illustrations produced by the author. However, the kind of information Zhang saw as necessary and relevant to readers was anatomical and biological, rather than focused on the application of such knowledge for agriculture. Through Zhang's use of illustrations, and the analytical framework he chose, knowledge of local plants and insects was conveyed to the reader through the lens of modern science.

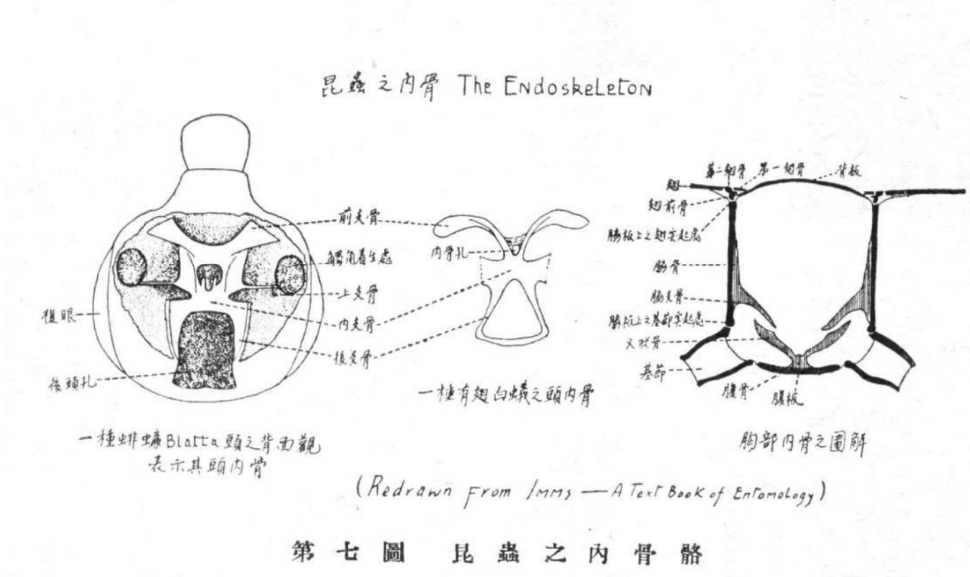

Figure 2.1: "The Endoskeleton." Zhang Jubo, "Collected Writings on Insects", *Kexue huabao* 1 no.17, 1934, 691.

In the article-series on insects, Zhang introduced different types of insects focusing on their life cycle, behavior, and anatomy. Zhang explained the classification of insects and their typologies and described at length the different organs of insects, such as their reproductive systems, eyes, flight mechanisms and limbs. Other installments discussed insects in relation to humans and to other plants, insect behavior, and their breeding activities. The articles were accompanied by photographs and illustrations, which, unlike many of the other images in the journal, were clearly attributed. Many of the photographs were taken by Zhang himself, and marked as "author's original" photograph. The illustrations that accompanied the articles were anatomical drawings of the different insects and plants discussed. In the case of the illustrations, some came from foreign textbooks, some were redrawn by Zhang from textbooks, and some were Zhang's original anatomical illustrations (Figure 2.1).

Zhang discussed his subject matter through the categories of anatomy and biology. Most of the information he provided was not meant for direct application by peasants. Even when discussing issues such as pest control and diseases carried by different pests, Zhang did not suggest any direct instructions on dealing with these problems. The texts and accompanying visuals were in the "universal" language of biology, using categories such as life cycle, mating patterns, and behaviors; and the visual language of dissecting and presenting each component separately. Zhang's articles are an example of how the magazine's editors and writers saw science as a universal method that could be applied anywhere to derive knowledge that was modern and legitimate.

The audience for this article series were not peasants who wanted to find out new ways to reduce the impact of pests on crops. A letter from a reader named Shen Huiyong 沈會永 from Shanghai sheds light on the possible audience for Zhang's writing. In the letter, Shen wrote that he enjoyed researching insects (*dui yu kunchong xihuan yanjiu* 對於昆蟲喜歡研究) and wanted more information about entomology and about Zhang's research.[198] He wrote that his knowledge was rudimentary, and he was not able to fully understand the articles published in *Kexue huabao*. He asked for suggested readings, in Chinese, for beginners with no

[198] "Shanghai Yao zhujiao lu Shen Huiyong jun lai han" 上海姚主教路沈會永君來函 (Letter from Shen Huiyong of Bishop Yao Road, Shanghai), *Kexue huabao* vol.3 no.4, 1935, 160.

knowledge. He also inquired about what objects and materials were required for studying insects. Last, he asked about Zhang himself: how did he start studying entomology, what were his methods and process? "Please explain in detail so that I can use (Zhang) as a model."[199]

Although Shen characterized himself as someone with only a basic education, who could not understand some of the terminology used by Zhang, he was not an illiterate peasant. He did not indicate his occupation, but his address was in Shanghai's French Concession, meaning he was an urban resident. Shen had access to the magazine, as well as to bookstores and libraries, and was literate enough to read it and compose a letter. His interest in entomology was academic rather than practical. He was interested in procuring some of the materials required to make samples and wanted to be able to understand the scientific terminology that Zhang used. What Shen was seeking was not a way to use scientific knowledge to help him in dealing with insects, as perhaps a farmer would, but to gain knowledge about insects that was scientific. In this example, the kind of science that would be considered by Wang Jiliang as "Chinese science", was not necessarily science that was applicable to Chinese peasants, but was of strictly academic use.

China-Made Science on a Global Stage

The magazine featured articles on contemporary scientific achievements in China, but did not frame them in terms of national strengthening. Rather, the global relevance of these achievements was highlighted as a way to position Chinese science on an equal footing with foreign science. Chinese science was not limited in its significance to the mainland but was discussed by writers in terms of its global position and contribution. The cover of the issue

[199] "Shanghai Yao zhujiao," 160.

published on October 10th, 1933 – which was Republican China's National day – was a photograph of a telescope in the Nanjing Purple Mountain observatory (Figure 2.2). The size of this large device was emphasized by the figure operating it, a Chinese man wearing a western-style suit, both hands occupied with manipulating the position of the telescope. The photograph's subtitle, "The largest refracting telescope in the Far East at Academia Sinica's Nanjing Purple Mountain Observatory" indicated the significance and ranking of the telescope beyond domestic boundaries, stating it was the largest in the Far East.[200] Featuring domestic science on the cover of the issue published on China's National day was a way to celebrate Chinese science, but the image was not directly linked to the date, nor did it offer any congratulations.

[200] Cover, *Kexue hubao*, vol. 1 no.6, 1933.

Figure 2.2: Cover, *Kexue huabao* 1 no.6, 1933.

The article about the observatory highlighted how it compared with astronomical technology globally. The author, Yu Qingsong 余青松 (1897 – 1978), was the head of the Astronomy department at Academia Sinica. Yu described the different apparatus in the observatory, the different kinds of lenses and how each was used. He explained that all the different machinery – the telescope's lens, the observation deck and the dome-shaped roof were mechanically operated and allowed the observer to easily change the telescope's position to capture different areas in the sky.[201] While describing the significance of the observatory, the

201 Yu Qingsong 余青松, "Nanjing Zijinshan tianwentai" 南京紫金山天文台 [Nanjing Purple Mountain Observatory], *Kexue huabao* 1 no.6, 1933, 211.

author wrote that it was the largest in China, and its lens was the largest in East Asia. The equipment was the newest kind of astronomical observation equipment available in the world, manufactured by the German lens factory Zeiss and costing 30,000 German Marks. Despite the date the article was published, no overt connection was made between this state-of-the art observatory and the Republican government (that funded the research institution in which it was located).

The author and the editors, who were responsible for the cover photo annotations, emphasized the importance of the observatory by discussing it in reference to astronomy research globally. Although the observatory was celebrated as a national achievement, it was written about in a way that made it important by its contribution to, and standing on, the international stage.

A similar approach was taken in an article series on the engineering and construction of China's first all steel bridge designed by a Chinese engineer, the Qiantang River bridge (Qiantang jiang qiao 錢塘江橋), located in Hangzhou province. The bridge's engineer, Mao Yisheng 茅以升 (1896 – 1989), obtained a Ph.D. in engineering from Cornell University in 1920. The bridge's construction began in 1934 and received praise and wide coverage in the media.[202] An article published in *Eastern Miscellany* (*Dongfang zazhi* 東方雜誌) on the eve of the commencement of construction, for example, declared it an achievement of national construction, especially admirable due to the current situation of national hardship, both

[202] "Qiantang jiang qiao kaigong zhi gan" 錢塘江橋開工之感 [Reflections upon beginning the construction of the Qiantang River bridge], *Jinghu tielu rikan*, November 1934; "Qiantang jiang da tie qiao" 錢塘江大鐵橋 [Metal bridge over the Qiantang River], *Shidai* 8 no.5, November 1934.

economically and in terms of military stability.[203]

The bridge was completed just before the outbreak of the battle of Shanghai in August 1937. It was not harmed during the attack, but as Japanese troops conquered Shanghai and were moving further inland toward Nanjing, the threat of the bridge falling into enemy hands became more acute. In November 1937, Mao received orders to explode the bridge to prevent Japanese troops from capturing it.[204]

Despite this dramatic backstory of an engineer having to destroy his biggest achievement, and the potential for constructing a patriotic tale of sacrifice for the good of the nation, the article series in *Kexue huabao* was rather dry and void of sentiment. The series was published in seven installments, from July 1937 to January 1938. Mao Yisheng wrote it before the bridge was demolished, and focused solely on the engineering aspects, from planning, to the kinds of problems that needed to be solved, to the mechanics of construction. It is telling, however, that the journal's editors did not make any comment on the demolition of the bridge and continued publishing the series. The editors did provide some commentary when the first installment was published in July 1937, just before the Marco Polo incident ignited the Second Sino-Japanese war. In the introduction to the article series, the editor wrote that the bridge was not just significant in China but had an important position in the global history of engineering ("Budan wei guonei kongqian zhi xiandai da qiao, zai shijie gongcheng shi shang zhan yi zhongyao weizhi" 不但為國內空前之現代大橋，在世界工程史上占一重要位置).[205] All

[203] Zuo Dan 作丹, "Qiantang jiang qiao kai gong" 錢塘江橋開工 [Construction starts on the Qiantang River bridge], *Eastern Miscellany* 31 no.23, 1934, 4.
[204] Xu Li 徐立, "Lun Mao Yisheng de gongcheng sixiang – yi Qiantang jiang jianqiao wei li" 論茅以升的工程思想 – 以錢塘江建橋為例 [Mao Yisheng's engineering ideology – a case study of the construction of the Qiantang River bridge], *Ziran bianzhang fa tongxun* vol 6, 2017; 138.
[205] Editor's preface, "Qiantang jiang qiao de gongcheng" 錢塘江橋的工程 [Engineering of the Qiantang River bridge], *Kexue huabao* 4 no.24, 1937, 976.

citizens of China, the editor wrote, should have deep knowledge of it.

The lack of comment on the war, on the bridge's significance in making the region potentially more vulnerable if captured by the Japanese, and on the sacrifice of a scientific achievement for national, political, and military consideration, is significant. One reason for this was that Mao's article was completed a month before it was published, before the outbreak of the war. The article was written as one piece and then divided into two to three-page segments by the editors. But the editors still made a conscious decision to not comment on the ongoing war in the parts of the series that were published after August 1937. This may have been an attempt to keep the journal as seemingly apolitical as possible, either to evade Japanese censorship or to not explicitly undermine the Guomindang.[206] Whatever the reason may be, the lack of acknowledgement of the bridge's significance in national defense, and the editor's choice to highlight it as an important development in global engineering projects, further exemplifies the journal's position that Chinese science was part of global science.

The Unscientific Past

The journal's writers saw modern science produced either in China or by Chinese researchers as legitimate, accurate, and sometimes on par with scientific knowledge production in the West. But how did the journal treat older understandings of the natural world? Canonical Chinese writings on the natural world, and the conceptual frameworks that underpinned them, were often invoked by way of comparison. Descriptions of flora and fauna in Chinese Materia Medica and similar elite texts were evaluated on how closely they reflected the "correct", i.e,

[206] Japanese soldiers came to the editorial office on at least two occasions and asked for the journal to be submitted to the Japanese Media Office. Services de Police, Rapport, April 1st 1938, SMA U38-2-679.

modern scientific, understanding. Rarely were these texts blatantly disparaged, instead, the authors who contributed to *Kexue huabao* characterized them as unscientific but mostly benign.

The Republican government, conversely, had a much less tolerant approach to understandings of the natural world it deemed superstitious. At the heart of the official rejection of certain ideas and practices was the Nationalist government's project of distinguishing "legitimate" religion from pernicious superstition in the service of building a modern nation-state.[207] In 1928, the newly established Nanjing government of the Guomindang party launched an "anti-superstition" campaign. Specific practices, including popular forms of healing that relied on magic rituals and texts, as well as geomancy, fortune telling, divination, and physiognomy, were cast as superstition and banned.[208] In an official document outlining which practices were legitimate and which were not, these practices were singled out for causing China to be the "laughingstock of the scientific world".[209] Superstition was an impediment to modernity, partly because it was unscientific.

The Correct Understanding of the Mandarin Fish

An article published in 1934 discussed the Mandarin Fish, a genus of perch fish found mostly in China. In this article, the author evoked different forms of traditional knowledge and contrasted them with a modern scientific understanding. The title of the article was "Peach Blossom Rains Bring an Abundance of Mandarin Fish," a line taken from the poem "Fisherman's

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[207] Rebecca Nedostup, *Superstitious Regimes: Religion and the Politics of Chinese Modernity*, Harvard East Asia Monographs 322, Cambridge, Massachusetts: Harvard University Press, 2009, 4-8.
[208] Nedostup, *Superstitious Regimes*, chapter 6; Prasenjit Duara, "Knowledge and Power in the Discourse of Modernity: The Campaign Against Popular Religion in Early Twentieth-Century China," *The Journal of Asian Studies* 50 no.1, 1991: 79 – 80.
[209] Quoted in Duara, 79.

Song" (Yu gezi 漁歌子), written by Tang-era poet Zhang Zhihe 張志和 (732 – 774).[210] Even if the reader would not immediately recognize this specific couplet, its style clearly indicated that it was classical verse. The author, identified as Zhi Zhi 質之, either a given name or a pseudonym, started the article with the entire couplet, and explained that the poet was inspired by hearing the songs of fishermen when spring rains flooded the pools. This couplet appeared in a collection titled *Poems and Illustrations* (Shi hua 詩畫). The first image in the article, which was placed right next to the first paragraph, came from that volume. It was a painting of a peach blossom branch hanging over a pond with two plump looking fish swimming in it (Figure 2.3). The image, Zhi Zhi wrote, demonstrated how beautiful this spring scene was, and that it would easily arouse a poet's sensibility.[211]

[210] Zhi zhi 質之, "Tao hua liushui Gui yu fei" 桃花流水鱖魚肥 [Peach Blossom Rains Bring an Abundance of Mandarin Fish], *Kexue huabao* 1 no.17, 1934, 643-647.
[211] Zhi Zhi, "Tao hua," 643.

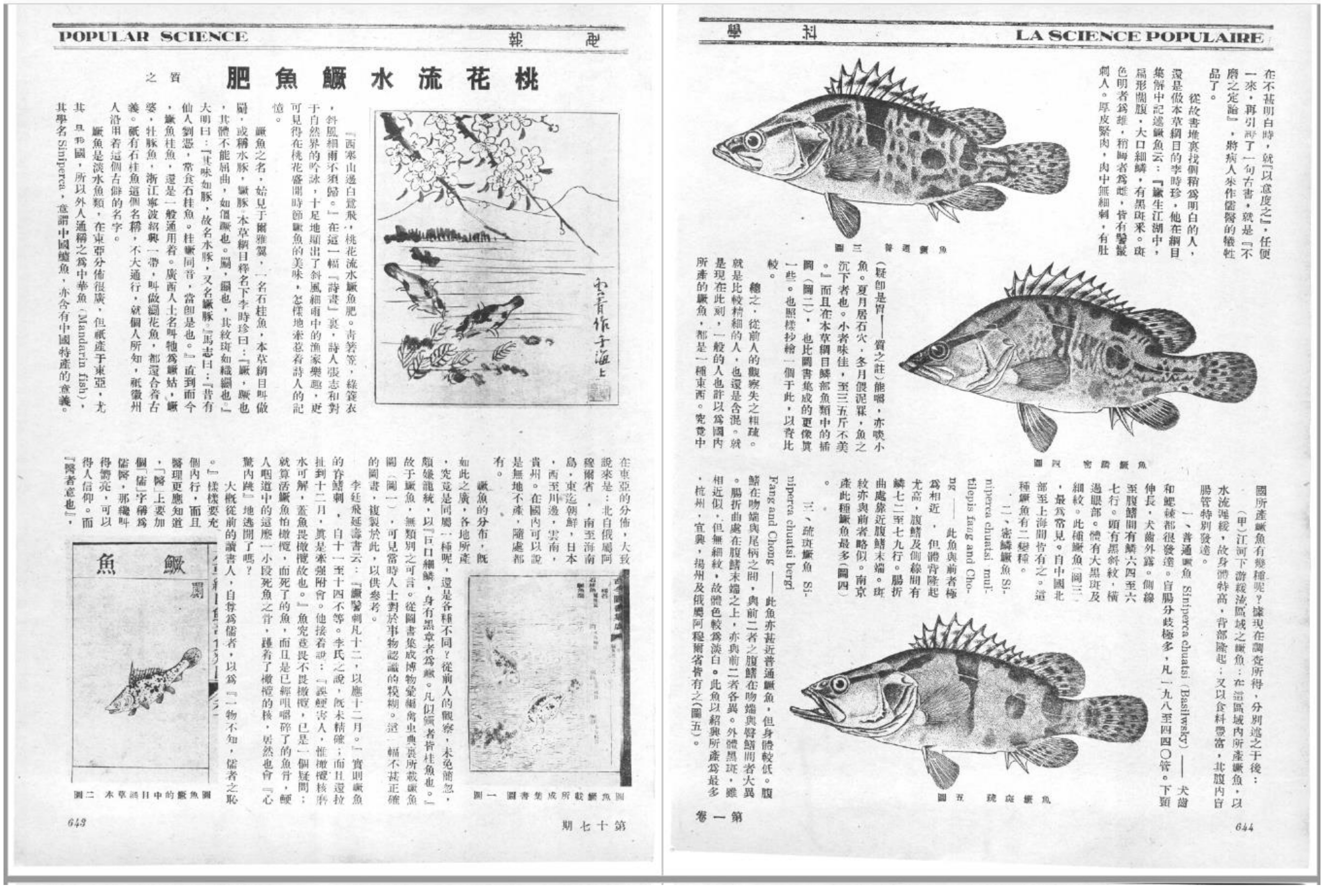

Figure 2.3: “Peach Blossom Rains Bring an Abundance of Mandarin fish,” *Kexue huabao* 1 no.17, 1934.

The next paragraph gave an overview of the names of this fish, starting with the different Chinese terms and moving to foreign designations. Zhi Zhi listed the names of the fish in different provinces in China, and the names it was given in Li Shizhen’s 李時珍 (1518 – 1593) *Systematic Materia Medica* (Bencao Gangmu 本草綱目), a text first published in 1596 that became highly influential for its comprehensiveness and new methods of collecting information.[212] Foreigners, the

[212] Li Shizhen and his materia medica were well known historical figures in China. There were many different versions of the *Systematic Materia* Medica, and it is not clear which one was used in this article. On the significance of this text, see Carla Nappi, *The Monkey and the Inkpot: Natural History and Its Transformation in Early Modern China*, Cambridge, MA: Harvard University Press, 2009, 6-11.

author explained, called it Mandarin Fish because it was prevalent in China. It's "scientific name" (*xue ming* 學名) was Siniperca. Following this was a paragraph on the distribution of the fish, where the author stated it could be found in most places in China. With such a wide distribution of this species, he asks, are they all the same? And if not, what are the differences among them? [213]

The first page of the article included three illustrations (see figure 2.3). One was the image from *Poems and Illustrations*, the second an illustration of the fish from a book titled *Illustrated Compendium of Birds and Insects* (Tuhua chengji bowu huibian qin chong dian 圖畫集成博物彙編禽蟲典), and another illustration from Li Shizhen's *Systematic Materia Medica*. The author used these illustrations to critique the knowledge gathered on the fish in the older texts. According to Zhi Zhi, the illustrations from the *Compendium* and the *Materia Medica* did not contain enough distinguishing traits, indicating that their authors did not really possess a clear understanding of its anatomy and characteristics. He considered Li Shizhen's version to be the most authoritative and informative among the different writings about Mandarin fish available, although still lacking in correctly identifying the large variety of species in this family. Zhi Zhi was using recognizable local materials while evaluating and critiquing them. The style of the first three illustrations was a distinctively Chinese one. The first painting was stylistically similar to Chinese paintings of nature, and the two illustrations from the reference books would be recognized as coming from Chinese sources if only because they included some text. An educated reader would probably recognize Li Shizhen's *Materia Medica* by its name, as it was a canonical text.

The images were not the only problem Zhi Zhi found in past Chinese writings. He also

[213] Zhi Zhi, "Tao hua," 643.

questioned the way information about the fish was gathered. . In the *Systematic Materia Medica*, Zhi Zhi wrote, Li Shizhen recounted stories of the healing properties associated with eating *guiyu*. One physician prescribed *guiyu* soup to a woman who suffered from consumption. After she added the soup to her diet, she got better. Li further corroborated the story by invoking two 8th century figures, immortal Liu Ping 劉憑 and hermit Zhang Zhihe (the author of the poem that opened the article), who also claimed that consuming the fish could increase the appetite, alleviate consumption, and even cure stomach parasites. Zhi Zhi characterized these accounts as "stories," and was dismissive of their scientific value. We should enjoy the fish, he wrote, for its delicious taste, and not believe claims about its healing powers made by immortals and hermits. This statement discredited what Li Shizhen viewed as legitimate sources of knowledge.[214]

Past accounts of the fish relied on crude observation (*guancha* 觀察) and treated *guiyu* as if it was one thing, when in fact there were many different varieties. Even today, Zhi Zhi wrote, this perception is common amongst most people. To correct this misunderstanding, he used "contemporary surveys" (*xianzai diaochao* 現在調查) that demonstrated the large variety among the fish.[215] Most of the article was dedicated to a categorization of the different types of fish in the genus and their characteristics. The article listed 12 different sub-types of the Siniperca, divided into five major categories according to their habitats. . The categories included those living in the lower reaches of slow-flowing rivers, those living in mountain rapids and others. Each sub-variety was characterized by its weight and the shape of its body, mouth, and dorsal fin. There were 14 illustrations of the different sub-types, large enough that the different characteristics could be discerned by the reader. Additionally, there was an anatomical

[214] Zhi Zhi, "Tao hua," 647.
[215] Zhi Zhi, "Tao hua," 644.

drawing of the different parts of the digestive system of the fish.[216]

This type of knowledge was presented as scientific in several ways: it was gathered through survey, as opposed to inaccurate observation and unverified stories appearing in the *Compendium* and *Materia Medica* from characters whose existence could not be proven.[217] The illustrations gave visual evidence to the differences observed in the different varieties. Finally, the act of categorizing into sub-varieties provided a systematic ordering which was further evidence of the "scientific-ness" of this knowledge.

In the article, different frameworks of knowledge about Chinese fauna were evaluated by the author, with a clear conclusion about which kind constituted scientific knowledge. Zhi Zhi did not completely discredit older forms of knowledge, and asserted the cultural significance of the fish in local cuisine and artistic expression. Although previous accounts of the fish were not scientific, they were also not presented as harmful or evidence of ignorance. The main body of the article was comprised of a categorization and description of the sub-varieties of the fish and the detailed illustrations. The validity of these descriptions came from the way they were collected and their cogent presentation. In the article's conclusion, the author suggested readers enjoy eating the fish now that it was in season. He encouraged readers to use the knowledge of the different types of the fish when they were enjoying a meal of it. This was the kind of scientifically-produced knowledge that the author hoped the readers would then retain for use in their daily life.

Science versus Superstition

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[216] Zhi Zhi, "Tao hua," 644 – 647.

[217] Observation in itself was not necessarily unscientific, However, Zhi Zhi called Li Shizhen's description of the fish "crude observation." "Tao hua," 644.

Other writers completely discredited certain kinds of Chinese knowledge. In an editorial about numbers, author Zhang Yanxiang 張延祥 argued for the necessity of using Arabic numerals.[218] According to Zhang, this system was preferable because of the history of mathematics in China was tainted by unscientific ideas. Although there was a rich history of mathematical research, Zhang lamented that it was coopted into practices of divination and physiognomy. Systems such as the Taiji diagrams, Eight Trigrams, and Ten Heavenly Stems and Twelve Terrestrial Branches may have relied on numbers, but they were used for impractical means and had nothing to do with mathematics or science.[219] Chinese numbers, Zhang argued, were too strongly implicated in these dubious modes of knowledge. Using Arabic numerals would be more conducive to scientific research, because it was not associated with what Zhang considered occult practices. "[The meaning of] Chinese numbers," he wrote, "has been occupied by false modes of thinking, therefore it is impossible to not advocate for the globally used Arabic numerals."[220] In this case, it was not a lack of knowledge that was perceived as a hinderance, rather, existing knowledge associated with Chinese numbers was seen by the author as a barrier to being scientific. It is also significant that Zhang referred to Arabic numerals as being used globally, presenting yet another reason they should be used – to make Chinese science legible on a global stage.

A similar approach was taken in an editorial titled "On Tigers" (Tan Hu 談虎), written by Xing Mei 醒梅.[221] In the first sentence, the author invoked the Chinese calendar: "According to the Heavenly Stems and Earthly Branches, this year is the 15th year of the cycle, which is

[218] Zhang Yanxiang 張延祥, "Kexue de jiben – Shu" 科學的基本– 數 [Numbers – the Basis of Science], *Kexue huabao* 3 no.4, 1935, 121.
[219] Zhang, 121.
[220] Zhang. "Kexue de jiben," 121.
[221] Xing Mei, "Tan Hu" 談虎 [On Tigers], *Kexue huabao* 5 no. 5, 1938, 1.

symbolized by the tiger, but we shall not consider the reasoning for this."[222] Although the author was quick to dismiss the reasoning behind the zodiac signs, he nevertheless evoked this familiar system and used it as an entry point to discuss the traits of tigers. Xing Mei called on other forms of older, native knowledge, to exemplify how people in the past understood tigers, and to contrast this with a scientific understanding of the animal. He quoted a poem titled "Lines about Vicious Tigers" (Meng hu hang 猛虎行) from Yuan dynasty poet Fu Ruojin 傅若金 (1303 – 1342), which demonstrated how in the past people were terrified of tigers.[223] In the following paragraphs, the author discussed tigers' behavior, size, preferred habitats, and reproduction and rearing practices. The author contrasted biological, natural knowledge of tigers collected through observation, with the knowledge derived from the Chinese zodiac and poems to show the reader the superiority of scientific knowledge.

The superiority of modern science was illustrated in the cover image of the issue which was a photograph of a tiger taken by F. W Champion, who researched tigers in the forests on the foothills of the Himalaya mountains. Xing Mei explained that Champion was able to capture the animal at such proximity because he studied their behavior, including the paths they traveled. Champion set up a camera and flash on one of the paths that would be triggered when a tiger would step on it. That is how he was able to take such a close-up photograph. Tigers are ruthless, the author wrote, but humans have intelligence and can use machines. Therefore, we should not be afraid of tigers, but use our intelligence and patience to control them.[224] Science can be used to make knowable, and thus tame, even the most ferocious animal. The reference to the zodiac was a

[222] Xing Mei, "Tan hu," 1.
[223] Xing Mei, "Tan hu," 1.
[224] Xing Mei, "Tan hu," 1.

way to make the discussed topic relevant to native traditions and to the date of publication. But at the same time, the author dismissed it as unscientific.

The articles described above discredited the scientific value of Chinese knowledge systems, but the authors did not go so far as to claim these ideas to be harmful. Furthermore, the authors did not invoke the term superstition, even for knowledge they considered irrational. In government science dissemination projects, such as the People's Education Centers (Minzhong jiaoyu guan 民眾教育館), science was presented as a cure for superstition. In an article published in the monthly circular of the Jiangsu Provincial People's Education Center, author Liu Jiajun 劉家駿 lamented that ordinary people were prone to believing in ghosts and the powers of shamans because they lacked understanding of basic principles of physics.[225] The "superstitious people of the countryside" (*mixin de xiangxia ren* 迷信的鄉下人) were easily tricked out of their money by ill-intentioned shamans and witches.[226] A lack of "common scientific knowledge" (*kexue changshi* 科學常識) left people to believe in ghosts and spirits. Liu described an example, which he claimed was a common trick used to con rural citizens. A witch would burn a piece of paper in a small earthen jug with a narrow opening. Then they would turn the jar upside down in a tub of water, resulting in a loud hiss as the water flowed into the jug. Without knowledge of the physical properties of air and water, people would believe the hissing came from a ghost, and would be convinced to pay the witch to get rid of it.[227]

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[225] Liu Jiajun 劉家駿, "Minzhong jiaoyu yu kexue changshi" 民眾教育與科學常識 [People's Education and Common Scientific Knowledge], *Minzhong jiaoyu yuekan* 民众教育月刊 1 no.12, 1929: 23.
[226] Liu, "Minzhong jiaoyu," 23.
[227] Liu, "Minzhong jiaoyu," 23-24.

But superstitions were not only harmful to people's wallets. They also posed a risk to the nation. According to Liu, superstitions about earth veins fueled domestic opposition to railroads, causing the Qing government to lose money to foreigners and hindering the industrial development of China.[228] Liu believed that the "problem" of superstition, evident by a rural landscape of shrines, temples, and monks, was caused by ignorance. Common scientific knowledge was therefore the answer.[229]

The main aim of the science department in the Nanjing People's Education Center was to give visitors "correct observations on and understanding of science", as opposed to the incorrect or superstitious ways ordinary people understood the natural world.[230] This proper understanding included knowledge on a broad range of topics, all of which were deemed relevant and necessary to people's lives. But it also included explanations about illness and natural phenomena such as rain and draughts, to counteract super-natural beliefs about these topics. In a science exhibition held in the Nanjing center in 1930, several dioramas pitted popularly held beliefs about illness against the scientific alternatives. One set of models was titled "A comparison of burning incense, seeking prescriptions from immortals, and calling on spirits and calling a doctor for treatment" (*kan xiang tou qiu xian fang jiao hun yu qing yisheng liaozhi zhi bijiao* 看香頭求仙方叫魂與請醫生療治之比較).[231] It compared different "superstitious" methods of addressing illness with seeing a biomedical doctor. In one diorama, a child was laying in a bed while a female shaman placed an incense stick on a table next to him. A woman knelt in front of the table, her hands

[228] Liu, "Minzhong jiaoyu," 22.
[229] Liu, "Minzhong jiaoyu," 23.
[230] Jiangsu Provincial People's Education Center, "San nian lai zhi kexue bu" 三年來之科學部 [Three Year Review of the Science Department], *Minzhong jiaoyu yue kan* 民众教育月刊 (People's Education Monthly), October 1930, vol. 2 no. 11-12, 3.
[231] Gezhong chenlie pin zhizuo fangan ji shuoming 各種陳列品製作方案及說明 [Plan of Manufacture and Explanation of Exhibition Items], *Minzhong jiaoyu yuekan*, July 1930, 18- 19.

clasped in prayer. Another diorama had a figurine of a man laying in bed, a small shrine with a buddha figure in front of him. Another scene depicted a dead body in a room, with a woman kneeling next to it, crying. On the other side of the diorama, a happier alternative was presented: a figure of a child in bed, with a male doctor feeling his pulse, and a woman – the mother – talking to the doctor. For the visitor who still did not understand the lesson imparted, an explanatory note read: "when someone is sick, you should call a doctor. You should not do useless things like lighting incense or calling spirits, which won't help but will lead to loss of life. Please consult this diorama to see how unreliable superstitions are."[232]

In these models, modern biomedicine, represented by a male professional, was depicted as the correct way to deal with illness. Traditional healing practices which included incantations, prayers, and divination – and the practitioners that supplied these services – were presented as dangerous. It is hard to measure the efficacy of these exhibitions in replacing these healing methods with bio-medical ones. Even if some of the rural visitors were convinced, access to biomedical infrastructure such as clinics, bio-medical doctors and midwives, and sterile equipment remained limited in rural China throughout the Republican period.[233] The mandate of the People's Education Centers was to disseminate new knowledge, and it was often pitted against practices and ideas characterized as superstition and subsequently vilified.

The Roots of Modern Chemistry

Instead of treating Chinese knowledge as an emblem of China's lack of "scientific-ness," *Kexue huabao*'s editors and authors saw these practices as part of a global unscientific past. Native

[232] Gezhong chenlie pin, 19.
[233] Tina Phillips Johnson points out that despite an increasing medicalization of women's health, most rural women relied on traditional midwives and not bio-medically trained one. Tina Phillips Johnson, *Childbirth in Republican China: Delivering Modernity* (Lanham: Lexington Books, 2011), 113.

practices and knowledge traditions were described as old or ancient knowledge systems. In some articles, authors referred to a shared human past, creating an equivalence of Chinese and foreign knowledge practices in the past, and contrasting them with contemporary knowledge. Thus, these knowledge systems were placed on a temporal axis in which their defining characteristic was not origin but time-period. This way of narrating the past meant that the problem of so-called erroneous understandings of nature was not unique to China, but a universal problem of temporality. In other words, before the advent of modern science, all societies were unscientific.

Figure 2.4: Cover, *Kexue huabao* 5 no.18, 1939.

This was the case in articles discussing alchemy, which was described by authors as the forefather of modern, scientific, and "correct" chemistry. As opposed to other Chinese knowledge systems, such as the Heavenly Branches or Taiji diagrams, alchemy was not considered completely un-scientific despite its connection to Daoist beliefs about immortality. Articles such as "China's Ancient Method of Preserving Bodies" (Zhongguo gudai shiti baocun fa 中國古代尸體保存法) and "Chemical Elements Known in Ancient Times" (Gudai yizhi de jizhong huaxue yuansu 古代已知道的幾種化學元素) evaluated some of the results of alchemy as legitimate knowledge.[234] The article on chemical elements, written by an author using the pseudonym Ci Yu 次玉, presented the chemical elements and practices of alchemists in different places, including Greece, Rome, India, Egypt, and China.

The cover on the February 1939 issue featured an illustration, unattributed, of two Daoist monks in a cave, surrounded by materials used for making immortality pills (Figure 4). The cover image accompanied an article titled "Alchemy – Ancient Chemistry," which discussed the alchemy in China and Europe.[235] The author began by referring to an important alchemy text, the *Baopuzi* 抱樸子, written by Ge Hong 葛洪 in the third century, and explained that the goal of alchemy was to make immortality pills. However, the author added that there were many practices associated with alchemy, including smelting, casting, and fermenting, which can be seen as the chemistry of the ancient world. The practice of alchemy, Jin wrote, originated in China during the Warring States period (475-221 BCE), and was marked by

[234] Feng Liutang 馮柳塘 "Zhongguo gudai shiti baocun fa" 中國古代尸體保存法 [China's Ancient Method of Preserving Bodies], *Kexue huabao* 9 no.2, 1942, 88-89; Ci Yu 次玉, "Gudai yizhi de jizhong huaxue yuansu" 古代已知的幾種化學元素 [Chemical Elements Known in Ancient Times), *Kexue huabao* 10 no. 10, 1944, 483-484.
[235] Jin Xuehu 金雪湖, "Gudai huaxue – jindan shu" 古代化學– 金丹術 [Alchemy – Ancient Chemistry], *Kexue huabao* 5 no. 18, 1939, 715-717.

making medicines and searching for immortality recipes. When invoking the different historical periods, such as the Jin dynasty, Han dynasty, and the Warring States, the author also included the corresponding years according to the Gregorian calendar, placing the dynastic history within the same time frame as the Western calendar.

Most of the article was dedicated to European alchemists and the idea of the Philosopher's Stone, a metal that originated all other metals. Accompanying the article were three illustrations of vessels used in the process of smelting cinnabar from texts compiled in the *Daoist Scriptures of Emperor Zhengtong* (Zhengtong dao cang 正統道藏, printed 1445), and one illustration from a German painter, Martin Joachim Schmidt (1718 – 1801), which was given the title "Alchemist." The article focused on European notions of alchemy, but most of the images, including the issue's cover, depicted Chinese alchemy. European and Chinese alchemy differed in many ways, including their political and religious contexts, and the practices and epistemologies they were associated with. But in this article, they were described as similar primitive versions of modern chemistry. The main reason alchemy did not survive, the author wrote, was due to the secrecy it was shrouded in. This in itself was an unscientific practice, since "open communication of knowledge is the life force of modern science" (xiandai kexue de huoli su 現代科學的活力素).[236] Despite alchemy not being scientific, Jin did not condemn it as useless or baseless knowledge. The author's tone was rather forgiving and almost amused, when he explained that it was a pity the reputation of alchemists was tainted by frauds pretending to forge gold, since even though it was a strange and fantastic practice, it constituted the sprouts of modern chemistry.

[236] Jin, "Gudai huaxue," 717.

It is significant that the writers in *Kexue huabao* rarely used the word superstition (*mixin* 迷信), which by the mid-1930s was a pejorative term linked to ignorance.[237] Nor did they treat traditional knowledge as potentially harmful in the way that Liu Jiajun did. Past knowledge was characterized as part of a relatively benign "unscientific" past. Furthermore, it was not a problem unique to China. Conceptualizing it on a temporal axis which contrasted past knowledge with modern science tampered an essentialist view of China of as non-scientific, and promoted a linear view of progress tied to modernity.

Universal Science and the Scientific Spirit

One of the problems of scientizing China was the implicit assumption that science was foreign and had to be adapted. More specifically, the equivalence of modern science with the technologically-advanced West created a problem for the generation of scientists who founded the China Science Society and published *Kexue huabao*. Many of these scientists, as we have seen in the previous chapter, were trained in the United States and Europe, and were versed and invested in the idea of modern science that emerged from disciplinary distinctions and increasing professionalization in the early 20th century. Promoting a view of science as a universal method of knowing the world enabled this group to reject the equivalence between modern science and the West, and claim legitimacy in producing scientific knowledge. Universalism, however, was braided with patriotism. The writers and editors of *Kexue huabao* were acutely aware of how science could be used to bolster national reputation and position a nation as a legitimate site for producing scientific knowledge. Scientific nationalism co-existed with scientific universalism.

[237] Nedostup, *Superstitious Regimes*, 8.

Lu Yudao and the Universal Brain

One of *Kexue huabao*'s editors who promoted the approach of universal science while also considering how science could be used for national purposes was Lu Yudao 盧于道 (1906-1985). Lu was a native of Yin district in Zhejiang province, and was drawn to psychology from a young age. In an essay on the brain published in a general magazine read by intellectuals, Lu wrote that as a boy he heard that German psychology was so advanced that a psychology expert (*xinli xue jia* 心理學家) could measure your brain waves while talking to you and know what you are thinking.[238] Inspired by Descartes' "I think, therefore I am", Lu was fascinated by what thoughts were and what mechanism generated them. Thinking was the thing that made us human, and Lu wanted to understand the physical mechanism that was responsible for it. As a child, he believed science could provide an answer to the question of what thoughts were, but as an adult scientist he realized that science was far from resolving these questions.[239]

In this narration of his path to scientific research, Lu's motivating question was of a universal nature – what did it mean to think? He foregrounded his own curiosity and intellectual interests, hinting at his facility with foreign texts and thinkers. Significantly, his account did not include any kind of patriotic sentiment driving his intellectual pursuit. This is not because Lu was not patriotic – as we will see, the opposite was true. But he chose to portray his backstory as driven by a quest to solve a universal problem. Doing this signified to the reader that Chinese scientists did not have to define their research only in relation to their nation. They could also be legitimate authorities on matters relating to all mankind.

[238] Lu Yudao 盧于道, "Nao yu sixiang," 腦與思想 [The Brain and Thinking], *Dongfang zazhi* 31 no.8, 1934, 15.
[239] Lu Yudao, "Nao," 16.

Lu majored in biology and psychology at Dongnan University, where he graduated in 1926 with a bachelor's in science. He then received a provincial scholarship to study abroad, and obtained a Ph.D. from the Anatomy program at the University of Chicago in 1930. His research focused on brain anatomy, and his dissertation, which analyzed the frontal cortex of the opossum, was published in 1931 in the Journal of Comparative Neurology.[240]

Like others who were involved in producing *Kexue huabao*, Lu participated in making scientific knowledge both abroad in a foreign language (English), and in China; and his career straddled professional science and popular writing. After he returned to China in 1930, Lu held different teaching and research positions. He started as an associate professor at the Shanghai Medical School, and in 1931 got a position as a researcher at the Institute of Psychology at Academia Sinica in Nanjing, where he worked until 1940. During this time, he published his research findings in professional journals both in Chinese and in English.

While conducting research and engaging in professional scholarship, Lu was also active in producing popular scientific materials. He volunteered to join the editorial team of *Kexue huabao* in 1933, and contributed several editorials throughout the 1930s. He also wrote regularly for the magazine, including a series of articles on the brain's anatomy, titled "Illustrated Anatomical Biology" (Shengli jiepou tushuo 生理解剖圖說), which was published in seven installments between August and December of 1933. Lu also edited a popular science book titled "Science: An Introduction" (Kexue gailun 科學概論), published in 1942 as part of a series of encyclopedia for youth.[241] Lu spent most of the war years in Chongqing, and called on scientists to divert their resources and attention to the immediate needs of the war. Scientists,

[240] Lu Yudao, "The Forebrain of the Opossum," *Journal of Comparative Neurology* 52 no.1, 1931, 1-148.
[241] Lu Yudao, *Kexue gailun*, 科學概論 [Science: An Introduction], Chongqing: Zhonghua wenhua fuwu she, 1942.

he wrote, should not be above the demands of the government or the marketplace.[242] After the Chinese Communist Party came to power in 1949, Lu abandoned professional research to focus on science popularization. He became the head of the Shanghai Committee for Popularizing Science and Technology (Shanghai kexue jishu puji xiehui 上海科學技術普及協會）in 1950, and was the editor in chief of *Kexue haubao* from 1952.

Lu Yudao's position on the question of where science came from was spelled out unequivocally in a 1936 editorial entitled "The Movement to Scientize China" (Zhongguo zhi kexuehua yundong 中國之科學化運動).[243] He argued that it was impossible to completely differentiate what is Eastern and what is Western culture and learning. Arabic numerals, he pointed out, were widely used around the world. Other non-Western inventions, such as Greek philosophy and the Chinese-invented compass, were also incorporated into science globally.[244] Although most scientific progress during the 19th century was made in the West, Lu believed that Chinese people should employ the fruits of scientific progress without it being seen as "Westernization" (*xiyang hua* 西洋化), because knowledge was meant to be shared and enjoyed by all. Lu did not believe that everything foreign was better – he wrote mockingly about Chinese people believing the number thirteen was unlucky, adopting foreign superstitions. But adopting science, according to him, was not the same as blindly copying foreign practices. "Science is universal, it is not Western," he wrote. Therefore, using modern

[242] James Reardon Anderson, *The Study of Change: Chemistry in China 1840-1949* (Cambridge: Cambridge University Press, 1991), 313.
[243] Lu Yudao, "Zhongguo zhi kexuehua yundong" 中國之科學化運動 [The Movement to Scientize China], *Kexue huabao* 3 no.24, 1936, 1. The editorial was not about the Guomindang sponsored Association for the Movement to Scientize China, but about the general idea of how to make China scientific.
[244] Lu did not see Greece as part of the West. This is further indicative of the constructed nature of categories such as East and West.

science in China was not the same as adopting Western practices.[245]

This universal science included the principles, methods, and spirit of science, which were not tied to nor inhibited by national borders or biology. According to Lu, China needed to independently undertake two projects – building research infrastructure and popularizing science. Lu did not believe there was anything inherently backwards or unscientific about China or Chinese people. People in the west, he claimed, held superstitions as well. He attributed the lack of scientific progress in China to political instability rather than an intrinsic deficit. Scientific thought was something attainable to any nation, if the two avenues of research and popularization were pursued.[246] Lu's insistence that science was not Western stemmed from the historical view of the contribution of Ancient Greece, Egypt, and China, as well as from his belief in a universal scientific methodology.

While maintaining that science was universal, Lu Yudao was not blind to the political uses research findings could have. He was also not averse to using science to strengthen the nation. Lu advocated for the establishment of an "Ethnicity Research Institute" (*minzu yanjiusuo* 民族研究所) that would use science to address questions about nation and ethnicity.[247] This was an especially pressing matter, according to Lu, since Western powers such as the United States and Britain were already doing so. Research on different ethnic groups which was done in places like the British Museum allowed Westerners to build national unity on the one hand, and develop better methods to invade other countries by studying their ethnic characteristics on the other. It was imperative, then, that China

[245] Lu, "Zhongguo zhi kexuehua," 1.
[246] Lu, "Zhongguo zhi kexuehua," 1.
[247] Lu used the term *minzu*, which could mean nationality or ethnic group, but is different from race (*zhongzu* 種族). However, in the discussion that follows race is sometimes closer to what the historical actors were referring to. Lu Yudao, "Chuangshe minzu yanjiu suo jianyi," 創設民族研究所建議 [A Proposal to Establish a Nationality Research Institute], *Qingnian jie* 1931,1-11.

produces its own research findings on its own ethnic groups.[248]

In this article, Lu addressed research on brain anatomy that was used to prove the existence of anatomically distinct races, and their respective capabilities. One of these researchers was Joseph Lexden Shellshear, professor of anatomy at the University of Hong Kong. In an article published in the *Journal of Anatomy*, Shellshear argued that after surveying 400 brains of Chinese people, which were "in the fresh condition, as well as in the preserved state," he observed a clear "Mongoloid type" and that this type of brain was inferior to the European brain.[249] Lu did not negate the idea that brain anatomy was a valid way to rank different peoples. Rather, he wanted China to have a research apparatus of its own to be able to compare, analyze, and classify the different ethnic groups in China and around the world.

Shellshear's research, Lu wrote, was an extreme insult to Chinese people. However, using the scientific method would allow others to replicate the research and propose other hypotheses.[250] Lu conducted a similar study which compared preserved brains and skulls, and although he found the differences in the brains of white and Chinese people that Shellshear reported, he maintained that these differences did not constitute inferiority.[251] Lu believed the scientific method was objective and blind, and could allow him and other Chinese scientists to contest claims of ethnic inferiority. At the same time, he did not contest the validity of comparing the traits of different peoples and creating ethnic, or racial, hierarchies.

Claims of science's universality legitimized Chinese actors to be part of the production

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[248] Lu, "Chuangshe," 1-2.
[249] Joseph Lexden Shellshear, "The Occipital Lobe in the Brain of the Chinese with special reference to the Sulcus Lunatus," *Journal of Anatomy* 61 no.1, 1926, 1.
[250] Lu, "Chuangshe," 4.
[251] Yanyan Qian, Chen Wei and Shengjun Wen, "Yu-Tao Loo and the Development of Neuropsychology in China", *Protein and Cell* vol. 8 no. 7, 2017: 474.

of scientific knowledge. This idea underpinned a series of articles Lu Yudao wrote for *Kexue huabao*, "Illustrated Anatomical Biology". The series focused brain anatomy. Each installment dealt with one of the five senses, explaining their physiological mechanism in the brain and how they connected to the organs associated with each sense. The first installment introduced the brain's main functions and their location, and the idea of the human body as a machine. The editor's introduction to the series highlighted how important it was to have knowledge of the brain, since it was "the commander of the body and mind," and that every person had to have at least some knowledge of how it functioned.[252] However, seeing as this was a complex and mysterious topic, only a specialist could be trusted to explain it. Therefore, the editor commissioned Lu, an expert in Neurology, to write the text and choose the images, in order to give readers the most accurate description with the best illustrations.[253]

In this series of articles, Lu described the different functions of the brain in universal terms. Speech, breathing, taste, smell, touch, and vision all operated in the same manner for every human being. When describing these functions, Lu referred to "humans" and "humanity" (*ren, renlei* 人, 人類) rather than any specific group. The images chosen to accompany this series similarly carried this universalist message, despite coming from Western sources. The first installment, which consisted of four pages, had seven images, several of them adapted from the British publication *The World of Wonder*. One illustration featured a portrait of a woman, with small circles in her head, each containing a man or woman performing an action, such as looking or smelling (Figure 2.5). Each circle was placed on the place corresponding with the brain area responsible for the action. The female figure in the image was clearly Western, and the editors chose to maintain

[252] Editor's introduction, "Shengli jiepou tu shuo: nao de gongzuo" 生理解剖圖說：腦的工作 [Illustrated Anatomical Biology: The Brain's Work], *Kexue huabao* 1 no.1, 1933, 2.
[253] Editor's introduction, "Shengli", 2.

rather than change it. This was perhaps to save some time in the process of putting the issue together, but an important change was made. The editors added text in each circle, denoting the brain function it referenced, such as “balance” (*ping heng* 平衡) or “hearing” (*er jue* 耳覺). Not changing the person in the illustration to look more Chinese, while overlaying it with Chinese text blurred the boundaries of nationality and reinforced the idea of science as universal.

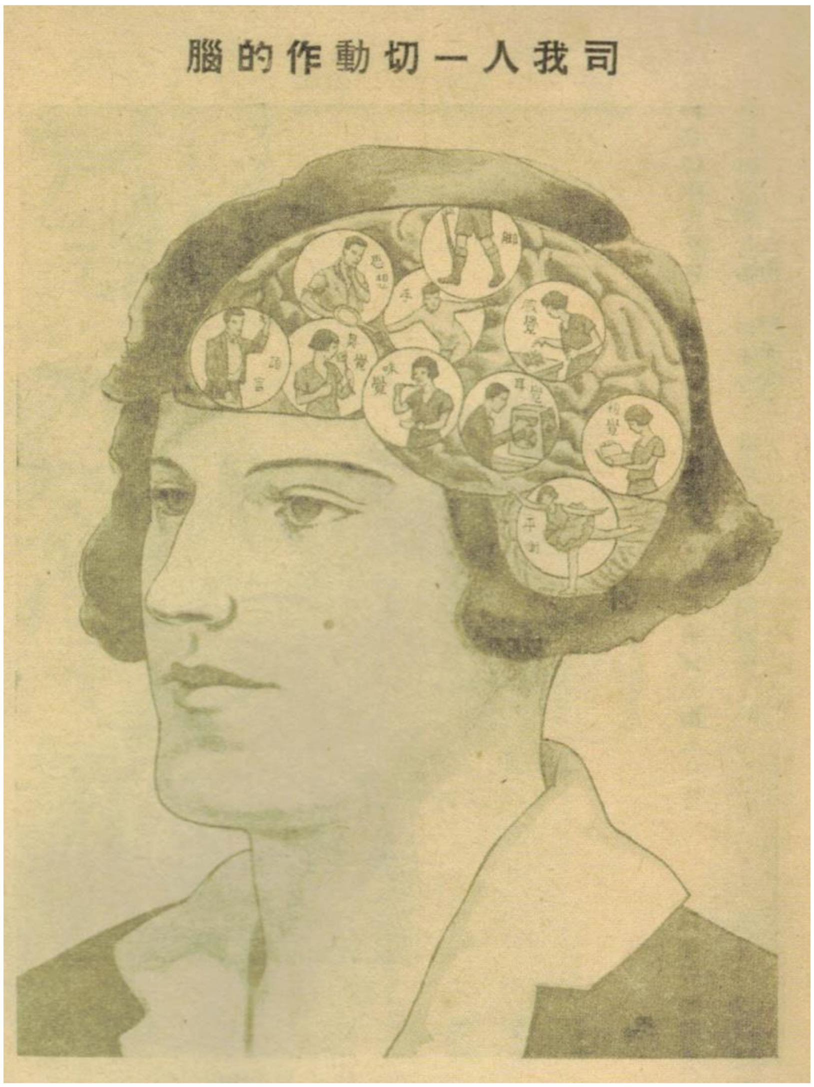

Figure 2.5: “The Brain, Manager of all my Actions”, *Kexue huabao* 1933 1 no. 1, 3.

Lu’s own expertise, which was highlighted in the editor’s preface, was again underscored through the image. In the annotation that accompanied the image, the editor noted that a mistake was made in the placement of the speech and smell areas in the original illustration, but the mistake was only noticed after the image was reproduced so it could not be corrected. The editors did not mindlessly reproduce these images from foreign publications and accept their authority without question, just as Lu did not accept the authority of Shellshear's conclusion. *Kexue huabao* was not just relying on foreign sources but adapting, critiquing, and improving them. By adopting the scientific method, Chinese scientists and science popularizers were asserting their own authority to produce knowledge of their own. Although the authority of the image was compromised, the authority of the magazine was strengthened.

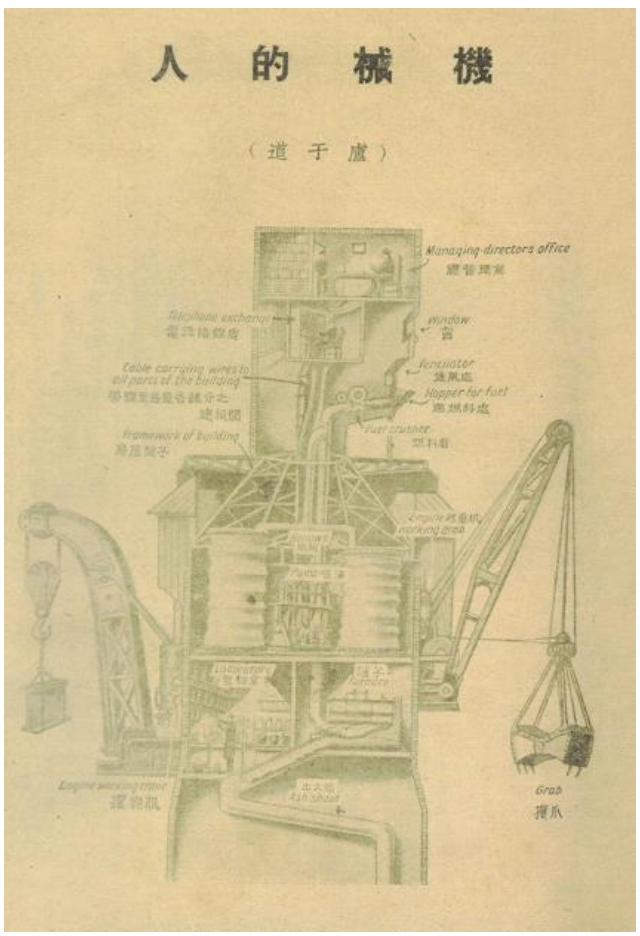

Figure 2.6: "The Mechanic Human"
Kexue huabao 1 no.1, 1933, 5.

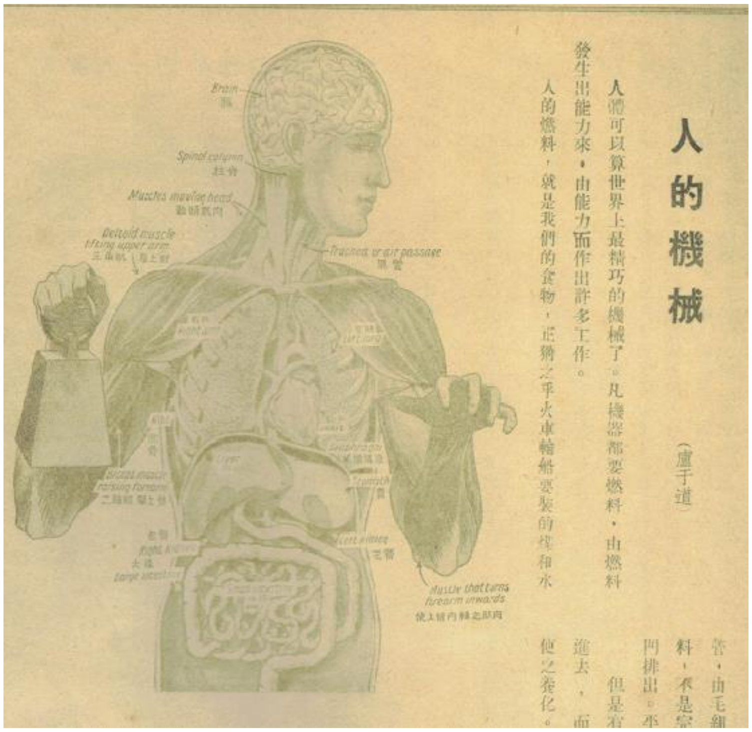

Figure 2.7: "The Mechanism of Humans" *Kexue huabao* 1 no.1, 1933, 4.

The next two sections of Lu's article dealt with general human physiology equating the body to a machine. The section titled "The Mechanic Human" (jixie de ren 機械的人) was accompanied by an illustration equating the human body to a factory, with the brain as the managing director (Figure 2.6). On the opposite page was an image entitled "The Mechanisms of Humans" (ren de jixie 人的機械) which portrayed the internal organs of a human male from the torso up to the head (Figure 2.7). The different organs were labeled both in English and in Chinese. These images of the body as a machine also appeared on a public health poster published by the Shanghai Students Books and Arts Society in August 1933, the same month in which they appeared in *Kexue huabao*.[254] However, the version on the public health poster was slightly changed: it had Chinese labeling in place of the English labels, and the figures were

[254] "Renti hao xiang gongchang" 人體好像工廠 [The Human Body is Like a Factory], Chinese Public Health Poster Collection, United States National Library of Medicine. https://www.nlm.nih.gov/hmd/chineseposters/index.html.

changed slightly to appear more Chinese. This image most likely also came from an illustration published in *The World of Wonder* in 1932. In the context of the Chinese-language journal, the image also reinforced the idea of similarities across all humankind. The image in figure 6 focused the viewer's attention on the internal organs of the body, which are the same for all people. Figure 5 supported this idea by completely erasing the human features and equating all bodies to machines, with no exterior characteristics to distinguish one from the other. The selection of these images reinforced the idea of science as an equalizer, a methodology that was blind to power and nationality. From a biological point of view, all humans functioned in the same way, and could all be understood through science.

The Scientific Spirit

What made science universally applicable? If the conditions for scientific research, including funding, resources, equipment, and machinery, were different in different countries, something that the foreign-trained scientists who wrote and edited the journal knew very well, how could this method be applied anywhere? Some writers sought to distinguish between the material conditions of science and the essence of science, the "scientific spirit". In the editorial "What is Scientization" (Shenme jiao kexue hua 什麼叫科學化), Cao Huiqun 曹惠群 made a distinction between the material culture that science produced and the scientific spirit.[255] Powerful and successful foreign countries relied on material culture that was the product of science. However, Cao argued, the road to scientize China was not to import or copy these objects. Purchasing, copying, or using "ready-made" technologies based on inventions from foreign countries, Cao argued, did not equal "scientization". You could buy planes and artillery,

[255] Cao Huiqun, "Shenme jiao kexue hua" 什麼叫科學化 [What is Scientization], *Kexue huabao* 1 no.2, 1933, 1.

build skyscrapers and roads, or enjoy listening to the radio and eating ice-cream. But these material emblems of science and modernity, according to Cao, were not an indication of the nation's progress. These would only contribute to consumerism, not to domestic production. Rather, Cao identified scientization as possessing a scientific spirit and implementing the scientific method.[256] Creating a division between material infrastructure and immaterial conditions was a way to claim that China could be scientized despite the lack of means, compared to wealthy countries in the West.

Cao's understanding of what it meant to be scientific was morality based and relied on an individual's character. While he identified the products of science, such as artillery, cars, and ice-cream, as things that originated from foreign countries and were imitated or adopted in China, the scientific spirit was not an import but a set of characteristics that could be cultivated internally. The scientific spirit was a set of morals and principles, first among them a devotion to one's work and a willingness to work hard. A scientist needed to be pure of heart, honest, and committed. Only this way, he argued, could one overcome the difficulties of conducting research.[257]

This view was shared by Chinese scientists as they established their professional identities, ethos, and authority. The ability to endure the tough conditions of field work was part of establishing the legitimacy and credentials of ethnographers during the Republican period. As Tong Lam argues in his work on social science research, experiencing and withstanding "bitterness" was part of constructing the moral identity of a researcher, and lent

[256] Cao, "Shenme jiao," 1.
[257] Cao, "Shenme jiao," 1.

authority to the scientific data generated through ethnographic surveys.[258] While this view of morality as a basis for scholarly work resonates with the Confucian ideal of self-cultivation through learning, scientists at the time denounced different elements of "traditional" Chinese scholarship based on Confucian traditions. The Neo-Confucian school of thought called "evidential scholarship," which was popular during the late Qing dynasty in the 19th century, derived its claim to veracity from philology and textual analysis. But China's new cohort of foreign trained scientists derided this kind of textual scholarship, and believed that scientific truth was rooted in positivist "facts."[259] In his work on experiments in Republican China, Fa-ti Fan argues that the scientific method of experiment was constructed as the opposite of the Confucian intellectual ideal. Confucian scholars accepted everything written in books, but modern scientists used their hands and eyes to do experiments.[260] Professional scientists, as we see in these examples, confronted the role of material conditions, whether by being resilient in the face of tough and uncomfortable field work, in the case of surveyors conducting research, or in asserting that tools needed for experiments were critical to making authoritative conclusions. *Kexue huabao*, aimed as it was at non-professionals with little to no access to scientific tools took the stance that cultivating the right personality for research could be a first step, even if the infrastructure for doing so was lacking.

After establishing the scientific spirit as the first step, the next step was adopting the scientific method. Cao summarized it as "collecting facts, analyzing cause and effect systematically, using induction to form a reasonable conclusion and a plan on how to

[258] Tong Lam, *A Passion for Facts: Social Surveys and the Construction of the Chinese Nation-State 1900-1949*, (Berkeley: University of California Press, 2011), 110-114.
[259] Lam, *Passion for Facts*, 42-43.
[260] Fa-ti Fan, "The Controversy over Spontaneous Generation in Republican China: Science, Authority, and the Public," in Elman and Tsu, eds., *Science and Technology in Modern China 1880s-1940s* (Leiden: Brill, 2014), 235.

advance."[261] The scientific method was based on empirical observation and the logical process of induction, and the scientific spirit was based on one's own character. Although "collecting facts" implied conducting experiments, Cao did not specify any material requirements. Therefore, by focusing on the moral characteristics of the scientific spirit and the theoretical aspects of the scientific method, Cao was able to put forth a view of science that did not rely on having material resources to be put into action. In this way, any reader could be a scientist, provided they embody these qualities and ways of thinking. In the same way, China could be scientific without having an established scientific research infrastructure.

Conclusion

Scientizing China and sinicizing science were two important missions for scientists, educators, and politicians in Republican China. But the relationship between China and science was a matter of discomfort and contestation. Despite the entanglement of nation and universe, *Kexue huabao*'s road to scientizing did not go through the path of "localization." Rather, they wanted to integrate their readers into an imagined sphere of transnational knowledge about science. The idea of science as universal allowed the editors and writers of *Kexue huabao* to decenter Europe as the birthplace of science, and to make a claim about the legitimacy of scientific knowledge production in China. At the same time, the category of nation could not be ignored. Scientizing China was an imperative that focused on the nation, and on the belief that modern science would transform China into a modern nation.

Chinese science in the journal was defined primarily by the object of study and the

[261] Cao, "Shenme jiao," 1.

nationality, or ethnic background, of the researcher. When Wang Jiliang called for more "Chinese science," he meant modern scientific knowledge produced by Chinese people about natural phenomena in China. This type of science did not have to include indigenous understandings, although sometimes it did. It mostly utilized the methodologies of modern scientific disciplines such as anatomy and biology. Both in Zhang Jubo's series on insects and in Zhi Zhi's writing on the Mandarin Fish, knowledge about China was legitimate "science" when it was produced using the practices of anatomy. This knowledge did not have to be useful to nation building or to "ordinary" people in China in order to be seen as Chinese science. But at the same time, the belief in science's universality and relevance to humans in general is what allowed Lu Yudao to discuss not just the "Chinese" brain, but the human brain. This is one way in which the national and the universal intersected.

The writers and editors of *Kexue huabao* did not believe China was inherently "unscientific." Older Chinese natural knowledge was mostly regarded not as an impediment to modernity but as relatively benign vestiges of the past. Thinking about science through a temporal axis, rather than a geographic one, allowed the journal to argue that China was not unable to be scientific, but that it needed to progress in order to integrate modern science. While China of the past could not produce knowledge that was scientific, most writers believed that China of the present could. This chronological view of science also contributed to the idea of science as universal. The unscientific past was a global human condition: ancient knowledge in Europe was also not fully scientific.

The scientific spirit was another key element of viewing science as universal and accommodating the categories of China and science. The scientific spirit was based on the procedures of empirical observation and experiment and inductive reasoning, as well as on a morality emphasizing "truth seeking", a commitment to scientific truth. Science educators were aware of the material factors that impeded Chinese development of modern science, including political upheaval, imperialist exploitation, and economic difficulties, but these were not insurmountable barriers. A focus on the non-material aspects of scientific knowledge production, namely, the scientific spirit, promised readers that they too could be "scientific" by adopting a certain attitude and way of thinking. In this way, they could start being scientific without needing specialized equipment of institutional access. These different ways presenting science in *Kexue huabao* linked scientizing China to creating a global science.

Chapter 3: Science and War

Introduction

The first issue in the fifth volume of *Kexue huabao* was published on August first, 1937, three weeks after the Marco Polo Bridge incident which escalated the tensions between China and Japan, and signaled the start of the all-out war between the two countries. The opening editorial was dedicated to an event that occurred on July 20th, ten days before the issue was published: the death of Guglielmo Marconi (1874-1937), an Italian inventor who developed long range wireless telegraphy (Figure 3.1).[262]


悼 馬 可 尼

Figure 3.1: "Dao Makeni" 悼馬可尼 [Mourning Marconi], *Kexue huabao* 5 no.1, 1937, 1.

Although the piece was not directly related to the dire domestic circumstances, and its main subject was a foreign inventor, the author used it to engage in a longstanding discussion in *Kexue huabao* about the role of science. Two different views of science existed in this debate: the first propagated science as a tool for national strengthening. The second viewed it as an international

[262] The question of whether Marconi invented wireless telegraphy had been disputed both by his contemporaries and in later historical research. One example is Sungook Hong, *Wireless: from Marconi's Black Box to the Audion*, (Cambridge, Massachusetts: The MIT Press, 2001), 1-2, ch. 2.

enterprise for the good of humankind, which required scientists to put the benefit of humanity over benefit to their nation. When the war erupted, this question became more urgent as science was simultaneously celebrated and decried for its role in developing military technologies, and scientists were expected to mobilize and support the war effort. Was science a tool to fortify a nation and equip it to battle with other nations, or a way to unite the world and benefit humanity? How could it serve both purposes? Now that China was at war with Japan, and soon the entire world would be at war, the stakes of this discussion were even higher.

The editorial on Marconi was representative of how both these positions existed in the journal. The author, Cao Zhongyuan 曹仲淵 (1892 – 1972) started by emphasizing that science was a force to unite different nations. [263] He wrote in the plural first person, expressing a collective mourning over the death of a great scientist, whose contributions were enjoyed by every nation, and whose inventions benefited all mankind. His death was described as a loss to the world of science.[264] His work was appreciated by people of all countries, including China, and his passing was grieved around the globe. But this internationalist tone was complemented and complicated by addressing the problem of China's techno-scientific inferiority.

The article portrayed Marconi and his story as an exemplary tale for China's youth, parents, businessmen, and scientists. Cao's portrayal of Marconi's life and achievements were carefully selected to suggest a role for each section of society in the mission to make China "strong and

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[263] Cao Zhongyuan 曹仲淵 was a wireless engineer. In 1928 he went to England to study in Marconi's wireless telegraphy school. After returning to Shanghai in 1932, Cao established the Dahua Wireless Company 大華無線電公司. He was also the author of several books on wireless telegraphy and wrote a biography of Marconi. Yuhuan xian difangzhi bangongshi 玉环县地方志办公室, *Yuhuan xian renwu zhi di san bian* 玉环县人物志第三编 (Gazetteer of notable people of Yuhuan county, 3rd volume), Beijing: Fangzhi chubanshe, 2016, 162-163.
[264] Cao Zhongyuan 曹仲淵, "Dao Makeni" 悼馬可尼 [Mourning Marconi], *Kexue huabao* 5 no. 1, 1937, 1.

prosperous" (*qiangsheng qilai* 強盛起來).[265] To become entrepreneurial scientists like Marconi, Cao advised Chinese youth to take note of the inventor's admirable characteristics, such as reading from a young age, conducting experiments, not giving up in the face of failed experiments, and patriotism.[266] Parents who wished to cultivate a passion for science in their children should encourage these pursuits. Cao highlighted the investment of 5000 Italian Lire, which according to the exchange rate at the time, was 3500 Chinese Yuan, from Marconi's parents, and later investments from "businessmen with foresight."[267] Science costs money, and Chinese businessman should open their wallets to fund promising research.

Cao concluded by addressing scientists: endless talk about China's backwardness was useless. Instead, they should learn from Marconi, go into the laboratory to seek survival and a way forward (*zhao shenghuo, zhao chulu* 找生活，找出路), alluding, perhaps, to the unfolding war. The article started with a commemorative tribute to a foreign inventor that suggested a unity among the scientific community that transcended national boundaries. His inventions were enjoyed by all mankind, and his memory should therefore be cherished by all. However, it then shifted to describe the relevance of Marconi's story to the particular challenges of China's science. This shift mirrors the tension in *Kexue huabao* between the universal nature they ascribed to science and its role in nation building.

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265 Cao, "Dao Makeni," 2.

266 The claim of Marconi's patriotism in this article is confusing, as he was an Italian by birth who later moved to England, where he registered his patents and found a market for his company. Cao argues that his refusal to give up Italian citizenship, and demand that his patents could be used by any nation, display his patriotic spirit. In this aspect as well, Marconi was a controversial figure.

267 Cao, "Dao Makeni," 2. This sum represented a significant amount of money. Wages for professionals such as lawyers, doctors, newspaper editors, or engineers ranged from 100 to 500 Chinese yuan per month, which enabled a middle class lifestyle. However, after the war started rising inflation meant that prices for food and fuel went up significantly. For information on salaries for professionals and the classification of middle class, see Xiaoqun Xu, *Chinese Professionals and the Republican State: The Rise of Professional Associations in Shanghai 1912-1937* (Cambridge: Cambridge University Press, 2004), 56-59.

The authors and editors of *Kexue huabao* believed that science was a universal system, not an attribute specific to any one nation. Through adopting the "scientific spirit" (*kexue jingsheng* 科學精神) and the "scientific method" (*kexue fangfa* 科學方法), discussed in the previous chapter, any nation could develop its own science. On the pages of the magazine, science was portrayed as an inherently trans-national endeavor. Discoveries, inventions, and new technologies had the potential to improve the lives of people around the world. But alongside the universalist approach, the people involved in *Kexue huabao* thought of science as an important way to transform their own nation.

What happened to the universal approach to science during the Second Sino-Japanese war? Not only was this a time of increased patriotic mobilization, but the journal's access to foreign magazines and textbooks was also limited due to disruptions in postal service. The following chapter examines the tensions between mobilizing science for the nation and viewing it as an international project beneficial to all mankind, in the context of the Second Sino-Japanese war and the Pacific War. The chapter first traces the changes in the publication and how the magazine's publishing body, the China Science Society, responded to the material challenges of war. *Kexue huabao* resumed its publication throughout the uncertainties of war, but it had to adapt by changing some of its content and publication schedule.

The second part of the chapter asks how the war impacted the journal's political alignment. Did the publisher and editors support the Nationalist government's calls for mobilization? Did the outbreak of war result in more patriotic discourse? I find that the journal did not abandon its claim that science was universal, but for the first time since it was published in 1933 it openly supported the Nationalist regime. Editorials in particular served as a platform for this message, as well as images of the Chinese army.

The third part of the chapter examines how the publication addressed the relationship between science and war. The growing destruction brought on by advancement in military technology gave rise to the question of whether science was responsible for war. This was a question of concern to scientists and science popularizers around the world throughout the interwar period and increasingly in the months leading to the outbreak of the war in Europe. How could the ideal of scientific development be justified, when Chinese cities and their population had suffered destruction brought on by new war technologies?

The chapter shows that most of these debates took place in the editorial section. Editorials were written by the journal's editors, as well as by invited guests, many of whom were scientists. The section presented a range of views from both professional scientists and popularizers. Most of the articles which directly supported the Nationalist government appeared in the editorial section. However, it was also a section which displayed a range of responses to the question of science's role during the war. The editorial section was referred to as *tonglun* 通論 in the magazine's index, which can be translated as general discussion. Its subject matter was often how science related to other aspects of life, such as society, politics, or economics. While social commentary was often embedded in the articles, in editorials it was front and center.

The editorial section was also the section over which editors had most control, as opposed to the magazine's articles which relied on images from foreign publications for illustration and for content. Content from foreign publications underwent significant reorganization and editing, and was not simply pasted into the pages of the magazine. However, the availability of images for a specific topic would be an important factor for a journal committed to the principle of "images and texts are equally important" (*tuwen bingzhong* 圖文並重). The editorial section, on the other hand, was not illustrated. It was one of several parts of the journal that was completely in the hands of the editors, without having to rely on materials or images from foreign sources. This was the section that featured most of the discussions about science and the nation and science and war. Editorials discussing science and war did not present a unanimous view, but they did share a common understanding of science. Writers in *Kexue huabao* made a distinction between "pure" science motivated only by a search for truth, and its application, or "misuse" for war purposes.

Wartime Publishing

From the outbreak of the Second Sino-Japanese war in the summer of 1937 to the end of the war in 1945, *Kexue huabao* underwent changes to its content, layout, print process, and print schedule. The China Science Society, which published the journal, faced financial difficulties, dislocation, and destruction, all of which impacted their publications. However, many society members continued their work under new and challenging conditions, and the society was able to maintain some continuity to its publications. *Kexue huabao* had halted its publication when the war reached Shanghai in August of 1937. In the next issue, which came out in October of 1937, the editors explained that publication is set to continue, but that wartime conditions might mean delays in printing and circulation.[268]

The society's buildings in Shanghai – its main office, the Mingfu Library (Mingfu tushuguan 明復圖書館), and the offices and printing workshop of the China Science Corporation (Zhongguo kexue tushu yiqi gongsi 中國科學圖書儀器公司) were located in the city's French concession, and were not harmed during the battles in Shanghai and after the Japanese army took over the city. In the following months, however, Japanese military officers, sometimes in civilian clothes, arrived at the society's library and printing house to search the premises. According to a

[268] "Ben bao qishi" 本報啟事 [Journal announcement], *Kexue huabao*, 5 no.2, 1937.

report made by Yang Xiaoshu 楊孝述, the society's secretary general and publisher of *Kexue huabao*, and Xu Yuanhou 徐淵厚, director of the China Science Corporation, Japanese soldiers conducted an illegal search of the printing house and library on February 25th, and again on March 2nd of 1938. The Mingfu library's manager, Wei Baosheng 衛寶生, was asked to go to a meeting with a Japanese officer who threatened to imprison him, along with the library's other employees.[269] Yang Xiaoshu reported these incidents to the French consular service. The French police report noted there was a cause for concern for the building's safety, because the society held crates of valuable manuscripts sent from the National Library in Beijing in 1936. The Japanese requested that the China Science Society submit copies of *Kexue huabao* to its Office of Press Censorship, but the society refused, and hired a private guard for their office.[270]

The society's buildings in Nanjing, which included an office and the China Science Society's Biology Research Institute (Zhongguo kexue she shengwu yanjiusuo 中國科學社生物研究所), were destroyed by Japanese attacks. The staff of the Biology Research Institute had evacuated to the Beibei 北碚 area in Chongqing in December 1937, during the Nationalist party's retreat from its capital city. They also packed 83 crates of materials to ship to Chongqing, which were entrusted to society board member Zhu Kezhen 竺可楨, who at the time served as president of Hangzhou University. The research institute's building was burned on January 12th, 1938, along with the specimens and equipment which could not be taken out.[271] In addition to the loss of research materials, the society encountered financial difficulties since its different revenue sources diminished. Revenue from the sale of books, scientific equipment, and specimens through the

[269] Services de Police, Rapport, March 2nd 1938, Shanghai Municipal Archives U38-2-679.
[270] Services de Police, Rapport, April 1st 1938, Shanghai Municipal Archives U38-2-679.
[271] Executive Council of the China Science Society, Notes from the 137th meeting of the Executive Council of the China Science Society, June 29th, 1938. ZKDZ: DSHJ, 234 – 235.

China Science Corporation dwindled, and membership fees were not paid.[272] However, the society made up for some of this by renting out what remained of their buildings in Nanjing and Shanghai, and additional support came from members who donated money and books.[273]

Despite the destruction, relocation, and personal grief and hardship caused by the war, the China Science Society continued functioning, even though they could not expand their research infrastructure. Many of China's scientists shifted their research agenda to adapt to the loss of laboratory space and equipment, or to being dislocated from their field research.[274] Membership in the China Science Society continued to grow, although at a slower rate. Between 1937 and 1942, displaced science students from occupied areas around Shanghai flooded the Shanghai concession areas, which led to an increase in the number of borrowers who registered at the Mingfu Library, so much so that the executive council voted to charge a fee for lending out books. The arrival of these "refugees" to Shanghai presented opportunities as well. Yang Xiaoshu solicited two society members who arrived in Shanghai to translate and edit a book series on civil engineering based on materials from an American correspondence school.[275]

Continuing to publish became a patriotic mission during this time. According to Yang, printing books on science was more important than ever, since it lay the foundation for post-war rebuilding.[276] However, interruptions to postal services, rising print costs, and the migration of

[272] Executive Council, Notes from the 137th meeting of the Executive Council of the China Science Society, ZKDZ: DSHJ, 234.
[273] Executive Council, Notes from the 148th meeting of the Executive Council of the China Science Society, December 19th, 1940, ZKDZ: DSHJ, 250.
[274] See the example of members of the Geological Survey in Grace Shen, *Unearthing the Nation: Modern Geology and Nationalism in Republican China* (Chicago: The University of Chicago Press), 2014, chapter 5.
[275] Executive Council, Notes from the 145th meeting of the Executive Council of the China Science Society, July 24th, 1940, ZKDZ: DSHJ, 246.
[276] Executive Council, Notes from the 137th meeting of the Executive Council of the China Science Society, June 29th, 1938, ZKDZ: DSHJ, 234-235; Yang Xiaoshu, "Zai minzu kangzhan zhong de kexue gongzuo" 在民族抗戰中的科學工作 [The Role of Science in the People's War of Resistance], *Kexue huabao* 5 no.2, 1937, 1.

many editors and contributors inland, meant that printing had to be reduced. The war took a mental and emotional toll as well. In a 1943 article reflecting on the magazine's ten years of publication, Yang candidly wrote that during the first year of the war the editors, himself included, could not muster the drive to continue the demanding schedule of publishing the journal twice a month.[277] *Kexue huabao* changed from a bi-monthly to a monthly publication schedule in 1938.[278]

The journal's sales were reduced in half, from 10,000 copies printed per issue to 5,000 that year, but publication nonetheless resumed.[279] Prices for everyday necessities in Shanghai skyrocketed after the Japanese took over the city, and as the prices of paper and copper printing plates rose, the journal's price increased from three to four *jiao*.[280] After Japanese forces seized the French and International concessions in Shanghai in 1942, the China Science Society moved its printing to the South-Western city Guilin. Paper molds (*zhixing* 紙型) for printing had to be shipped from Hong Kong to Guilin, which further increased the price of printing.[281] Despite these challenges, operating the printing house and continuing to publish the society's journals was now a patriotic mission and a way to support the war effort.

Another way the China Science Society was able to maintain some of its operations was through its relationship and communication with science societies and publishers abroad. Liu Xian 劉咸 (1901 – 1987), the editor of the society's professional journal, *Kexue* (科學 Science), wrote to science publishers in Europe and the United States with which the society had subscriptions,

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[277] Yang Xiaoshu, "Shi nian hui yi" 十年回憶 [Recalling Ten Years of Publication], *Kexue huabao* 10 no.1, 1943, 22.
[278] Volume five, which started in August 1937, still included 24 issues, and therefore ran until June 1939. From the sixth volume in July 1939 onward, each volume had 12 issues published monthly.
[279] Executive Council, Notes from the 137th meeting of the Executive Council of the China Science Society, June 29th, 1938, ZKDZ: DSHJ, 234.
[280] "Shanghai wujia zeng zhang" 上海物價增漲 [Prices increase in Shanghai], *She you* 社友, 1939, 4.
[281] Yang, "Shi nian," 22.

asking them to supply free copies of their publications due to the society's financial hardship, a request which most of them granted.[282] Many of the articles in *Kexue huabao* were based on articles and papers from foreign scientific publications, and this allowed the magazine to maintain its claim to bringing readers the newest scientific developments from around the world.

The war helped cement the country's international position, and many politicians and intellectuals felt a stronger sense of recognition of China's international position.[283] In 1945, Zhu Kezhen proposed changing the society's English name from the China Science Society to the Chinese Association for the Advancement of Science (CAAS), to promote its international standing and align itself with the American Association for the Advancement of Science (AAAS) and British Association for the Advancement of Science (BAAS).[284] Bing Zhi 秉志, a board member and zoologist supported the proposal, commenting that taken together, the AAAS, BAAS, and CAAS would form the "A, B, and C of international science."[285] Preserving its involvement with the international scientific community was crucial to the society's image as a representative of China in international fora.

Despite the attempts of society members to maintain their international connections, *Kexue huabao*'s transnational reporting was restricted during the war. Because of the scarcity of foreign news, the magazine's "Science News" (Kexue xinwen 科學新聞) column stopped being published in July 1942, Eight months into the Pacific War. Shanghai's international settlement, until then a

[282] Executive Council, Notes from the 140th meeting of the executive council of the China Science Society, August 26th, 1939, ZKDZ: DSHJ, 246.
[283] Diana Lary, "Introduction," in *Negotiating China's Destiny in World War II*, Hans van de Ven, Diana Lary, and Stephen R. McKinnon, eds. (Stanford: Stanford University Press, 2015), 1-2.
[284] Executive Council, Notes from the 153rd meeting of the Executive Council of the China Science Society, October 1945, ZKDZ: DSHJ, 271.
[285] Executive Council, Notes from the 153rd meeting of the Executive Council of the China Science Society, October 1945, ZKDZ: DSHJ, 272.

neutral zone, was taken under Japanese control, and postal services were cut off. The column had been a central part of the magazine from its beginning and occupied between five to ten pages per issue (issues normally had 52 pages). It featured short, news-like reports accompanied by one or two images. This section introduced new scientific developments, inventions, new records, as well as occasional oddities, sometimes from China but mostly from foreign countries. The reports came from foreign correspondents – society members living abroad – and from foreign newspapers. It was an important part of the magazine's mission to introduce readers to new scientific developments from around the world, and to integrate them into a global community of science readers.

Other columns also had to be discontinued temporarily. The Readers' Letters column stopped being published in January 1938, also due to disruption in postal service between Shanghai and Free China (i.e, the areas under Nationalist party control). While some readers' letters continued to be received, the editors could not easily communicate with the experts who were solicited to answer these questions.[286] A new column, "Common Knowledge Quiz" (Changshi ceyan 常識測驗), replaced it in engaging readers. Some quizzes were centered on one topic, such as glasses or film.[287] Some quizzes had questions on a variety of topics, including physics and chemistry, biology, geography, and others. In one instance, the quiz contained questions such as "what family does the lion belong to," "when it is winter in China, what season is it in Australia," and "what gas in the air is the one we depend on to survive".[288] Another column featured questions

[286] Zhang Jian 张剑, *Sai xiansheng zai zhongguo: zhongguo kexueshe yanjiu* 赛先生在中国：中国科学社研究 [Mr. Science in China: A Study of the China Science Society] (Shanghai: Shanghai Science and Technology Publishers, 2018), 207-208.
[287] "Shishi ni de dianying zhishi 試試你的電影知識 [Test your Knowledge of Movies], *Kexue huabao* 5 no.6, 1938, 245; "Shishi ni guanyu yanjing de changshi" 試試你關於眼鏡的常識 [Test your Knowledge of Eyeglasses], *Kexue huabao*, 5 no.8, 1938, 327.
[288] "Changshi ceyan" 常識測驗 [Common Knowledge Quiz], *Kexue huabao* 5 no.13, 1938, 529.

such as "how do you put out a fire caused by an incendiary bomb," "what kind of substance is mustard gas," and "what is the function of eyebrows."[289] The writer encouraged readers to first try and formulate an answer, and then look at those provided in the last page. The column did not have the same consulting function which the readers' letters column had, but it provided a way to directly engage audiences and encourage them be more than passive readers. The column appeared in 1938 but was discontinued at the end of the year. It returned, however, in the 13th volume published in 1947.

There was also a moderate increase in articles on military technologies and new weapons. At the onset of war, the magazine published a short-term supplement that was dedicated entirely to the war titled *Kexue Huabao's Wartime Special* (Kexue huabao zhanshi tekan 科學畫報戰時特刊). It ran for ten issues, from October to December 1937. The supplement contained between eight to ten pages per issue and included illustrations and photographs. The articles were dedicated to explaining different kinds of weapons and military gear, and how these functioned.[290]

Even before the Second Sino-Japanese war started there was a gradual increase in the number of articles relating to military technology and weapons. The fourth volume of *Kexue huabao* published between August 1936 and July 1937 had a series of 14 articles on chemical warfare ("Agents of Chemical Warfare" Hua xue zhan ji 化學戰劑), and each issue published in the volume had at least one article on armaments, navy, and air force technologies, and at times three or four.[291] In the fifth volume, published from July 1937 to June 1939, the number of articles on war technologies remained similar, with each issue featuring between one and four articles about

[289] "Changshi ceyan" 常識測驗 [Common Knowledge Quiz], *Kexue huabao* 5 no.16, 1938, 652.
[290] Chong Xi 重熙, "Fa kan zhi qu" 發刊旨趣 [Statement of purpose], *Kexue huabao: zhan shi te kan*, 1937, 1.
[291] "Kexue huabao di si juan suoyin" 科學畫報第四卷索引 [Index for volume four], *Kexue huabao*, 4 no.24, 1937, 1014.

military affairs and technologies.[292] In the volume's index, the section on arms (*junbei* 軍備) was the shortest of all categories. However, articles relating to war were included under other categories. For example, articles on military use of dogs and homing pigeons were categorized under biology, an article on building underground shelters under civil engineering, and the aforementioned article series on weaponizing chemical agents was categorized under chemistry.[293]

The table of contents from an issue published in June 1940 provides an illustrative example of the space that war occupied in the magazine. The first two articles, which together took up nine out of 52 pages, were about war: one was about different types of aerial bombs, the other on chemical warfare. The remaining articles contained pieces on non-war related topics, such as using steam to clean windows, the world's thinnest metal pipe, caterpillars, sound waves, and giraffes, among others. The Science News column contained seven pages, two of which featured news on military science. Many of the issues published during the war years were similar, having some content related to war but continuing to publish other articles and columns.

The only part of the magazine dominated by war was the editorial section. In the years between 1937 and 1941, half of the editorials in each volume were about the relationship between science, war, and society. Most of these articles were original pieces written by the editorial board and the magazine's writers, but some were translated pieces. Some editorials discussed the reasons for war, and whether scientists should take a stand for or against it. Others were on pressing questions such

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292 He Liang found a similar proportion in his study of the journal's wartime publication. He Liang 賀靚, "Kang Ri zhanzheng shiqi de kexue huabao yu qi kexue puji" 抗日戰爭時期的科學畫報與其科學普及 [Kexue huabao's Science Popularization during the War of Resistance] *Studies in China's Science and Technology Journals* vol. 25, 7 (2014): 882.

293 "Kexue huabao di wu juan suoyin" 科學畫報第五卷索引 [Index for the fifth volume], *Kexue huabao* 5 no.23-24, 1939, 963-968.

as whether death rays (*si guang* 死光) existed and could be deployed as weapons, or how factories could prepare themselves against air raids.

The magazine's covers throughout the war years also mixed war and non-war subjects. In volume five, around one third of the covers, seven out of 22, had images with a subject relating to war, depicting both Chinese and foreign scenes. Some examples include an illustration of a ferry carrying a tank to shore,[294] a new type of submarine,[295] and an illustration of a British antiaircraft cannon.[296] The cover of the issue published in November 1937, a few months into the war and a month shy of the Japanese capture of Nanjing, was an illustration of fighter jets with the blue and white insignia of the Nationalist Revolutionary Army (Figure 3.2). A cover from April 1939 depicted enemy jets bombing a Chinese city (Figure 3.3). In the volumes published between 1939 and 1945, a similar ratio of about a third of covers contained images relating to war.

[294] Cover, *Kexue huabao* 5 no.10, 1938
[295] Cover, *Kexue huabao* 5 no.17, 1939
[296] Cover, *Kexue huabao* 5 no.14, 1938

Figure 3.2: Cover, *Kexue huabao* 5 no.3, 1937

Figure 3.3: Cover, *Kexue huabao* 5 no.20, 1939

Because most of the covers were adapted from foreign publications, they tended to depict foreign subjects. However, images were often altered, and several covers were illustrated by the publication's artistic editor (*meishu bianji* 美術編輯), Hu Siliang 胡思良 (dates unknown). In volume five, 18 out of 22 covers had subjects which were clearly foreign such as a portrait of Marie Curie,[297] a soviet expedition to the north pole, and an image from the world fair held in New York city.[298] In contrast, only five covers in the same volume had explicitly Chinese subjects, such as a diagram from the plans for constructing the Qiantang River bridge (Qiantang jiang qiao 錢塘江橋),[299] and an illustration of a Daoist monk making immortality pills.[300]

[297] Cover, *Kexue huabao* 5 no.15, 1938.
[298] Cover, *Kexue huabao* 5 no.21-22, 1939.
[299] Cover, *Kexue huabao* 5 no.2, 1937.
[300] Cover, *Kexue huabao* 5 no.18, 1939.

Some of the covers portrayed a universal subject, an image not marked by a specific geography. These types of images were often depictions of natural history or of physical phenomena. One such cover carried a schematic illustration of the sun's shadow during an eclipse,[301] another was a color illustration of the light emission spectrum of different elements, such as iron and sodium, in contrast to the solar spectrum.[302] The cover of one issue had a photograph comparing the size of leaves that had been treated by chemicals to stop their growth. The accompanying article discussed how chemistry could serve plant biologists, and focused on several American scientists who were conducting experiments on potato leaves. The image on the cover presented the leaves as laboratory specimens against a white backdrop, obscuring the image's provenance.[303] Whether it was due to the magazine's mission to introduce readers to science from around the globe, or the reality of reliance on foreign publications for images, the covers in the magazine continued to represent world science.

The war impacted both the journal's content and the material conditions of publication. Factors such as obstructed postal communication, increasing printing costs, migration, switching the print operations to a different city, and the general hardship and chaos of war all took their toll. In addition to its reduced print run and publishing schedules, the number of images decreased after 1942. However, after adapting to the wartime conditions, *Kexue huabao* carried on publishing relatively as usual. The editors continued to include a wide range of articles in different scientific fields, alongside greater interest in the fast-developing technologies of warfare. As in previous years, the magazine continued to publish articles on science from around the world, maintaining

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[301] Cover, *Kexue huabao* 7 no.12, 1941.
[302] Cover, *Kexue huabao* 8 no.5, 1941.
[303] Chun Xi 春西, "Zhi wu huaxue jia de shenji" 植物化學家的神跡 [Miracles Discovered by Biologists and Chemists], *Kexue huabao* 9 no.4, 1942; 125, and cover.

its promise to readers to deliver "the world of science" to their doorstep. This continued even when Shanghai was cut off from communications with other parts of China and most of the world. A new concern about the relationship between science and war had emerged in this period, most evidently seen through the editorial section. This question was intertwined with *Kexue huabao*'s complex tension regarding science's position as universal or national.

<u>Universal and National Science during the War</u>

The onset of war presented a challenge to the understanding of science as a universal system of knowledge that had been prevalent in the magazine. Editorials focusing on the "scientific spirit" and the scientific method highlighted the universality of science, and detached it from expensive infrastructure or technological capabilities. The publisher believed that articles on scientific developments from abroad were equally relevant to readers as domestic ones. *Kexue huabao* blurred the national boundaries of scientific knowledge production in its images and articles.

What happened to the universalist narrative in *Kexue huabao* during the war? On the one hand, there were stronger displays of patriotism and alignment with the government in a way that did not occur prior to 1937. On the other hand, the journal did not abandon the narrative of science as universal. As the specter of another world war materialized, the role of science and scientists during wartime became globally debated issues, and the editors presented their own perspectives alongside those of American and British writers. The editorial board of *Kexue huabao* included their readers in a transnational conversation through translations and original articles addressing these topics.

Kexue huabao declared itself a “non-political publication for the purpose of education.”[304] The editorial policy of *Kexue* magazine – the China Science Society’s flagship publication – also stated that political matters or government actions should not be discussed in the journal.[305] Although many members of the China Science Society held positions in public universities and government, the society’s different publications did not support the Guomindang regime directly, nor were they overtly critical of it. At times *Kexue huabao* represented an alternative view of science to that of government sponsored popularization efforts, as seen in the example of the Nationalist party affiliated *Scientific China* discussed in chapter two.

The outbreak of war in 1937 required a more publicly articulated stand on how *Kexue huabao*, scientists, and science in general, contributed to the war effort. Yang Xiaoshu viewed the continued publication of the magazine as a patriotic act in itself, since it continued the important mission of science education. Scholars in mainland China have also interpreted the continuous publication during the war as an act of resistance.[306] Beyond that, the magazine published editorials and images which supported the government in more explicit ways that had not been common in the publication prior to the war. In the first years of the war, displays of patriotism in articles and images shifted the narrative of “science as a transnational endeavor” to one which highlighted science for national defense.

Professional Scientists and Wartime Debates

Throughout the war, the professional scientific community in China had to contend with different imperatives guiding their work. While China’s scientists generally saw themselves as

[304] C.H Fong (Feng Zhizhong 馮執中), correspondence with Consul General of France in Shanghai, June 1933. U38-2-679, Shanghai Municipal Archive.
[305] Ren Hongjun 任鴻雋 Zhongguo kexueshe lishihui qishi 中國科學社理事會啟事 [Announcement from the Executive Council of the China Science Society], 1935, ZKDZ: SX, 162.
[306] He Liang “Kang Ri zhanzheng,” 885.

patriots, during the war they were under increased pressure to adhere to national needs and submit to political supervision, by focusing on production and applied sciences. This happened both in Communist controlled areas and in those under Guomindang control. Furthermore, not all scientists opposed submitting to the demands of nation and party.

When the Japanese army conquered China's coastal cities, most research and education institutions moved westward to the areas controlled by the Nationalist party. Academia Sinica and the China Science Society's Biology Research Institute moved to Chongqing, the new government seat. China's three elite universities, Peking University, Qinghua University, and Nankai University, jointly formed the National Southwestern Associated University (Guoli xinan lianhe daxue 國立西南聯合大學, known as *Lianda*) under orders from the Ministry of Education, and relocated to Changsha in Hunan province, and later to Kunming.[307] Some scientists, along with many students and intellectuals, opted to move to the Chinese Communist Party's stronghold in Yan'an 延安, situated in China's North-West. James Reardon-Anderson argued that scientists both in Nationalist and Communist controlled areas faced similar expectations from political leaders to subordinate their research agendas to wartime needs, favoring applied science over "pure" research.[308]

Within the professional scientific community, political pressures were met with varying responses. Most scientists, whether in the Communist-controlled region or in Nationalist areas, recognized that there was an immediate need to find solutions for the problems generated by war. But at the same time they maintained that it was also important to devote resources to training in

[307] John Israel, *Lianda: A Chinese University in War and Revolution* (Stanford: Stanford University Press, 1998), 5.
[308] James Reardon-Anderson, "Science in Wartime China," in *China's Bitter Victory: The War with Japan 1937-1945*, James C. Hsiung and Steven I. Levine eds. (New York: M.E Sharpe, 1992), 213-214.

basic scientific principles and theories. Some scientists opted to resume work done on theoretical questions, and stressed that "basic science" (*jiben kexue* 基本科學) was the foundation for scientific work.[309] But the government continued directing resources to applied sciences, opening new courses in universities and encouraging enrollment in subjects like engineering.[310]

However, in some disciplines, wartime needs and theoretical work did not contradict one another. Geologists, for example, construed fieldwork as both useful to the nation and a basic requirement of their field.[311] The leaders of the Natural Science Institute (Ziran kexue yuan 自然科學院) established in the Communist stronghold of Yan'an, focused on training their students in the theoretical basics of scientific disciplines, arguing that students needed foundational training to understand applied fields such as engineering and mechanics. But the focus on theory eventually led to the institute being dismantled.[312]

The tension between the needs for applied and technical science and theoretical research existed across political boundaries, and responses from scientists depended not only on the ideological leaning of individuals, but also on the concerns of the specific field. One unifying element shared across political camps and disciplines, however, was a belief that science – whether in the form of research or applied technology – should serve the nation. Perhaps because many of *Kexue huabao*'s editors and writers were professional scientists, the debate on the need for pure science versus applied science found echoes in some of the magazine's editorials.

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[309] Reardon Anderson, "Science in Wartime," 217-218.
[310] J. Megan Greene, "GMD Rhetoric of Science and Modernity (1927-1970)," in *Defining Modernity: Guomindang Rhetorics of a New China, 1920-1970*, ed. Terry Bodenhorn (Ann Arbor: Center for Chinese Studies, University of Michigan, 2002), 231-232.
[311] Grace Yen Shen, *Unearthing the Nation: Modern Geology and Nationalism in Republican China* (Chicago: The University of Chicago Press, 2014), 166-173.
[312] Reardon Anderson, "Science in Wartime," 224-229.

Mobilization in Kexue huabao

An editorial by Yang Xiaoshu published in October 1937, as battles were being fought in and around Shanghai, argued that science was a "tool for reconstruction and a weapon in national defense."[313] The article, titled "The Role of Science During the People's War of Resistance," (Zai minzu kangzhan zhong de kexue gongzuo 在民族抗戰中的科學工作) outlined the publisher's position that scientists, science educators, and university students, should mobilize under the Guomindang leadership. Yang argued that scientists in all disciplines, including the "pure" sciences (*chuncui kexue* 純粹科學) of meteorology, astronomy, and physics, had a role to play in national defense, since they were indispensable for military operations and weapons engineering. Yang positioned applied science (*shiyong* 實用) against pure science, but emphasized that all scientific work was relevant to and necessary for national defense. Yang admitted that scientific research, whether pure or applied, did not lend itself to producing quick results. However, "practical concerns" (*shiji wenti* 實際問題) necessitated speeding up research.[314]

In the editorial, Yang called for full mobilization of science educators. Until now, Yang wrote, China's scientists have not been properly integrated into the mission of national defense, yet there was not one among them not willing to sacrifice themselves. He believed that the more comprehensive the mobilization of scientists during the war, the quicker the path to reconstruction. The article contained a plan for nation-wide mobilization to provide science education. Yang directed his plan at "people in science" (*kexue ren* 科學人), including educators, writers, and publishers. Publishers should focus on producing textbooks about national defense, and educators

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[313] Yang Xiaoshu, "Zai minzu kangzhan zhong de kexue gongzuo" 在民族抗戰中的科學工作 [The Role of Science in the People's War of Resistance], *Kexue huabao* 5 no.2, 1937, 1.
[314] Yang, "Zai minzu kangzhan," 1.

should plan short courses on national defense which included "scientific thought, technical skill in production, and the ability to endure labor and hardship."[315] Yang suggested that universities should set up temporary learning centers and dispatch volunteer teachers to deliver these courses in the countryside. Science educators should be put under a government-wide human resource management system, which will deploy them to areas where they are needed and supply them with a salary.[316]

An editorial written by Bing Zhi 秉志 (1886 – 1965), who was the head of the China Science Society's Biology Research Institute, also suggested a plan of action, this time focusing on how scientists should mobilize.[317] Similar to Yang's article, Bing also stressed that cooperation between scientists and the government was essential, and was similarly focused on immediate necessities, indicating his support for applied science. Bing identified seven main problems which scientists could help resolve. These were grain supply, industry, production of military supplies, transportation, medicine, education, and economy. Although these were "rearguard issues" (*houfang zhi wenti* 後方之問題), Bing wrote, they had a direct impact on battles fought on the front lines.

Bing suggested that interdisciplinary teams be put together to address each issue, as each of the problems was multifaceted and required experts in life sciences and social sciences. To arrange these teams, Bing proposed that the government should organize a survey to identify qualified personnel. Under government leadership, private businesses, scholarly associations, and education institutes should report relevant experts. Furthermore, all citizens should actively report and enlist

[315] Yang Xiaoshu, "Zai minzu kangzhan," 1.
[316] Yang Xiaoshu, "Zai minzu kangzhan," 1.
[317] Bing Zhi 秉志, "Ruhe liyong guonei zhi kexue jia" 如何利用國內之科學家 [How to Make Use of the Nation's Scientists], *Kexue huabao* 5:3, 1937, 1.

in this survey if they had relevant skills. The second stage was creating teams and deploying them to work on each problem. Scientists and educators were encouraged not just to cooperate with the government but to defer to it in setting their research and work priorities.[318]

Both Yang and Bing's articles advocated mobilizing under government supervision and subordinating research to fit an agenda dictated by national needs. However, they also emphasized that scientists from across all disciplines were needed for the war effort, as opposed to government officials who chiefly promoted education programs for industry and military engineering.[319] Yang and Bing did not discount the relevance of theoretical science at a time of crisis. However, they both viewed the different scientific disciplines through their potential contribution to strengthening the nation. While it was obvious that developing bombs was part of "scientific national defense" (*kexue de guofang* 科學的國防), other sciences were also crucial: geology and biology could help develop natural resources that would enrich the country; chemistry and agricultural science could improve grain production; and meteorology, math, and physics could be used to improve armaments.[320] Bing Zhi's article included social sciences in the list of areas of expertise needed for the war.[321] Both writers called for a full scale mobilization of scholars in all fields to provide the "back shield" (*hou dun* 後盾) that will defend the nation.[322] Yang's editorial in particular diverged from the focus on applied science, by stressing the importance of science education, a long-term goal that would contribute to post-war rebuilding rather than immediate defense concerns.

[318] Bing Zhi, "Ruhe liyong," 1.
[319] Greene, "GMD Rhetoric of Science and Modernity," 231.
[320] Yang Xiaoshu, "Zai minzu kangzhan," 1.
[321] Bing, "Ru he liyong," 1.
[322] Yang Xiaoshu, "Zai minzu kangzhan," 1.

In April 1939, the magazine printed parts of a speech given by Bai Chongxi 白崇禧 (1893 – 1966), one of the two main military leaders who served under Chiang Kai-shek. The speech was delivered to students at Zhejiang University, which relocated to the South-Western province of Guangxi. The speech was titled "Soldiers' War and Scholars' War" (*Bing zhan he xue zhan* 兵戰和學戰). Bai's main argument was that military service and scholarly pursuit should not be separated.[323] He noted that in ancient China, civil service and military service were not separated (*wen wu bu fen* 文武不分). Today, he claimed, the strength of the great powers comes from the fact that they provide military training to boys in primary, secondary, and tertiary education. Uniting military and academics, Bai argued, was the only way to strengthen the nation.[324] As a speech, Bai's address was meant to encourage its audience to volunteer for military service to fulfill their patriotic duty. As an article printed in *Kexue huabao*, it strengthened the position that science was inseparable from military affairs and necessary for national defense.

Images were also used to highlight the patriotic message. National Army soldiers were portrayed in photographs that showed them in action, often photographed from a lower angle to present them as heroic figures. One photo essay included a portrait of Zhang Zhizhong 張治中 (1890-1969), commander of the Beijing and Shanghai garrison, and photographs of soldiers using anti-aircraft artillery against Japanese bombers (Figure 3.4).[325] The magazine chose images depicting destruction of civilian, not military, targets, such as bombed train stations, residential areas, and hospitals.[326] A few months after the war started, the magazine's cover featured an

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[323] Bai Chongxi 白崇禧, "Bing zhan he xue zhan" 兵戰和學戰 [Soldiers' War and Scholars' War], *Kexue huabao* 5 no. 20, 1939, 1.
[324] Bai, "Bing zhan," 1.
[325] "Yi yue lai zhi Song Hu zhan" 一月來之淞滬戰 [One Month into the Battle of Shanghai], *Kexue huabao* 5 no.2, 1937, 44-45.
[326] "Zai hong zha zhong suojian" 在轟炸中所見 [Seen Amid the Bombing], *Kexue huabao* 5 no. 3, 1937, 86.

illustration of fighter jets with the blue and white National Army insignia chasing enemy jets with the title “Pursuit in the sky” (Gaokong zhuiji 高空追擊, see figure 3.2).

44 科學畫報 第五卷

一月來之淞滬抗戰

自八月十三日上午九時半日軍發射第一顆子彈後，遂展開大規模的淞滬戰爭。一月以來，日軍迭次增援，軍艦達百餘艘，陸軍五師團，海軍萬餘人，飛機二百餘架，傾全國精銳，大舉侵略。日本海軍更炮轟我沿海要塞，封鎖我全國海岸，大隊飛機不時襲擊我各省重要都市，對於非戰鬥之婦孺難民，紅十字會及文化機關亦濫施轟炸，以遂其征服大陸的迷夢。

我淞滬守土之忠勇將士，在沿江海狹窄之地帶，暴露於敵艦炮火敵機彈雨之下，前仆後繼，浴血抗戰，迄今扼住陣綫，且迭予敵人以重大之打擊，其犧牲精神之壯烈，實堪彪炳日月，垂萬古而不朽。

本頁上各種照片大都由國際社前方記者所供給，亦足以瞻此次神聖抗戰偉績之一斑。 二六・九・一八

京滬警備司令張治中將軍

我軍在羅店方面的野戰炮

我軍在吳淞陣地測量敵機飛翔高度（上），以便用高射炮（下）射擊。軍士器械均用樹枝樹葉偽裝，以欺騙敵機。

Figure 3.4: Excerpt from “One month after the Shanghai battle.” Top right photograph is Zhang Zhizhong 張治中. *Kexue huabao* 5 no.2, 1937.

Although *Kexue huabao* was far from being a mouthpiece for the Nationalist party, during the war it aligned itself more closely with it. The editors and writers encouraged Chinese scientists and educators to contribute to national defense, widely defined to include not just military affairs but the economy, industry, education, and civilian matters. Mobilizing science for national defense, therefore, was a legitimate and patriotic pursuit. However, as we will see in the next section, when discussing science outside of the framework of national needs, the relationship between science and military affairs was not wholeheartedly accepted or celebrated.

Is Science to Blame for War?

The editors and writers of *Kexue huabao* were concerned with the question of the culpability of science and scientists in the atrocities happening around the world and in China, brought about through new technologies. As a journal advocating the dissemination of scientific knowledge, it could not continue promoting a narrative of science's benevolence and benefit to all mankind without addressing its applications in war. New war technologies were often featured in the journal's articles, and the threat of poisonous gas attacks, chemical warfare, and incendiary bombs was palpable and immediate. How did the journal characterize the nature of scientific development in view of these new and deadly technologies?

The journal published on military affairs, weapons, and war technology well before the outbreak of the second Sino-Japanese war. The inter-war period in China was not peaceful: the 1920s were characterized by warlords in different provinces vying for control which often resulted in brutalizing the countryside. In 1927 the Guomindang, under the leadership of Chiang Kai-shek, went on a military campaign that wrested control from most warlords in Eastern China, although parts of the north and south remained beyond their control. That same year, Shanghai was the center of the White Terror, a campaign initiated by the Nationalist party to attack anyone suspected of communism. The 1930s saw increasing Japanese aggression, first with the annexation of Manchuria. In Shanghai, where *Kexue huabao* was published, tensions between Chinese and Japanese were increasing, leading to a three-month war in 1932 when the Japanese military bombarded Shanghai.

The discussion of new technologies was accompanied by an underlying anxiety over the potential of more harmful weapons, and how these might shape armed conflict in the future. When war officially erupted in 1937, the journal navigated between dispelling rumors of deadly weapons with scientific evidence, introducing readers to new war technologies, and providing information on defense strategies. The editors and writers also discussed the role of science and scientists in creating war.

A complex discourse about science and war emerged in editorials, articles, and through images. In articles and editorials that discussed weapons and war technologies, writers described in detail their harmful effects. However, they also often referred to the other side of the coin – scientific progress created weapons, but it also produced defense mechanisms against those weapons. Science was not presented as completely blameless, but it was acknowledged that it could be used both for destruction and for protection.

Although *Kexue huabao*'s writers continued to advocate for the necessity of science, they also started to acknowledge its limitations as a tool of social enlightenment. The government, social organizations, and even human nature, all had a role to play in how science was implemented in society, in mitigating harm, and in preventing war. Writers also attempted to separate science from its application, to maintain their position that ultimately science was a benevolent force. The concepts of a pure scientific spirit and scientific method were key in this, as was a characterization of scientists as inherently good, motivated only by a search for truth and not by material gains or desire for power.

Killer Monsters: The Specter of Technology

The possibility of a second world war and the kinds of technologically advanced weapons it would involve were the focus of a 1934 article by Xi Bo 錫伯 (dates unknown), titled "Killer

Monsters of the Next Great War" (Weilai da zhan zhong de ji ge sha ren mo 未來大戰中的幾個殺人魔).[327] At this point in time, the author wrote, the idea that after 1918 there would be no more great wars was a falsehood or a daydream. The sense of imminent danger in the article's title was compounded by the issue's cover, which featured an illustration of an imaginary above land battleship (Lu shang zhanjian 陸上戰艦, figure 3.5).[328] The illustration showed the fictional warship positioned on tank tracks, which served as launch pads for planes. The upper deck had cannons, and the gigantic vehicle was heading towards a town, crushing houses on its path.

Figure 3.5: Cover, *Kexue huabao* 2 no.6, 1934.

Xi Bo wrote that the post-World War One hope of wars being over was naïve. Every country knows another large-scale war was coming, he wrote, and so do we. It is not a question of whether another war will start, but where the first shot will be fired. While no country will admit

[327] Xi Bo 錫伯, "Weilai da zhan zhong de ji ge sha ren mo" 未來大戰中的幾個殺人魔 [Killer Monsters of the Next Great War], *Kexue Huabao* 2 no.6, 1934, 212-214. The images in this article and the cover of the issue came from the cover and article published on October 1934 in American popular science magazine *Everyday Science and Mechanics*, however the article in *Kexue huabao* was not a direct translation.
[328] Cover, *Kexue Huabao* 2 no.6, 1934.

it wants to start the fighting, knowing that a global conflict will soon erupt is the reason the great powers are developing their military capabilities.[329] Utilizing science for developing weapons, according to Xi Bo, was a necessity of the times. Even though rumors of new poisonous gases or "death rays" were questionable, they nevertheless sent army generals and scientists to the lab, spurring an arms race. While it was impossible to confirm the existence of these weapons, every rumor had a grain of truth, Xi Bo wrote. The article introduced a few imaginary weapons, including the pictured tank battleship crossover. The author concluded on a less than reassuring note, writing that "while these monsters are completely hypothetical for now, they may play a role in a future war," suggesting that whenever the next war will happen, it will involve new and more powerful ways to cause destruction.[330]

A similarly grim forecast of what the next global war will entail was presented in a special issue dedicated to military affairs, published in April 1936. The cover featured a photograph titled "modern soldiers" (*xiandai de zhanshi* 現代的戰士, figure 3.6). The photo showed four soldiers emerging from behind a bush, dressed in khaki uniforms. Their human features were almost completely obscured: they wore wide metal helmets, and gas masks covered their entire faces. Three soldiers in the background were pointing their rifles at the viewer, while the soldier in the foreground was crawling on the ground.

The menacing effect of this photo was echoed by other articles in the issue. An article titled "Ground Forces in the Second Great War" (Di er ci da zhan zhong de lu shang zhanzheng 第二次大戰中的陸上戰爭) described what the first morning of the war would look like: people would be awakened by an earth-shattering sound, followed by incessant explosions. The streets would be

[329] Xi Bo, "Weilai da zhan," 212.
[330] Xi Bo, "Weilai da zhan," 212.

filled with men, women, and children, fleeing from collapsed houses. Fires would be burning everywhere, water and gas pipes will erupt, flooding the streets and emitting noxious gases. Shortly after, gas bombs would fall from the sky, killing any survivors. This scene, the author warned, will only be the beginning of the war.[331] The article discussed the developments in military technologies since World War 1, including tanks, chemical and biological warfare, new kinds of bombs and explosives, radio devices, and paratrooopers. The author concluded that in the past decade, science and engineering had continously improved these technologies. The next great war, therefore, will be even deadlier than the previous one.

Figure 3.6: Cover, *Kexue huabao* 3 no.18, 1936.

Other articles in this issue similarly linked science's advances and inventions to developing the tools that will be used for massacre and destruction. "Modern Warfare Tactics" (Xiandai zhanshu 現代戰術) featured photographs of the Chinese army during the 1932 Shanghai war.[332]

[331] Wang Xing 王興, "Di er ci d zhan zhong de lu shang zhanzheng" 第二次大戰中的陸上戰爭 [Land-based Battles in the second great war], *Kexue huabao* 3 no.18, 1936, 708.
[332] Ju Xun 巨勳, "Xiandai zhanshu" 現代戰術 [Modern Warfare Tactics] *Kexue huabao* 3 no.18, 1936: 712-716; Wang Chang 王常, "Julie de zhayao" 劇烈的炸藥 [Volatile Explosives), *Kexue huabao* 3 no.18, 1936: 725.

These articles and images approached warfare from a technological perspective, but they did not shy away from presenting it as the gruesome, violent, and terrifying experience it was. The readers were made acutely aware of the potential damage and harm of these new weapons.

Anxiety over new weapons continued after the outbreak of the war. One of the main sources of concern was chemical warfare. Chemical weapons, including mustard gas, were first used by Germany during the First World War, and were subsequently banned from use in war by the 1925 Geneva Protocol. However, scientists in Germany, Britain, the United States, and Japan, continued experimenting and refining them.[333] When a second global conflict became an increasingly likely possibility, governments and armies expected that chemical weapons would be used, despite the international protocol forbidding their use.[334] The Japanese Imperial army used chemical warfare in China at least as early as 1938. The most common chemicals used were tear gas and sneezing gas, but there is also evidence of use of mustard gas both in Northeast China and in the South and interior.[335] Available records indicate that chemical weapons were used in battles in or near major cities, and that civilian populations in China had close encounters with gas bombs during the war.[336] As opposed to the imagined hybrid tank featured on the cover of the magazine in 1934, chemical weapons were an invisible, but real and immediate threat to the Chinese population.

A series of articles titled "Chemical warfare" (Huaxue zhan 化學戰), authored by Meng Xinru 孟心如, a chemistry researcher at Nanjing Central University (Nanjing zhongyang daxue

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333 Kim Coleman, *A History of Chemical Warfare* (New York: Palgrave MacMillan, 2005), 40.
334 Coleman, *Chemical Warfare*, 59.
335 Awaya Kentaro, "Japanese Mustard Gas in China: Then and Now," *Sino-Japanese Studies* 4.2 April 1992: 3-6; Walter E. Grunden, "No Retaliation in Kind: Japanese Chemical Warfare Policy in World War II," in *One Hundred Years of Chemical Warfare: Research, Deployment, Consequences* eds. Bretislav Friedrich et al. (Springer International Publishing, 2017), 267.
336 Awaya, "Japanese Mustard Gas," 4. The number of casualties from chemical warfare reported by the Nationalist party to the International Military Tribunal of the Far East in 1946 included civilian and military deaths, but did not include casualties on the Communists side.

南京中央大學), was published in eight installments from 1936 to 1937. In this series, Meng explained – sometimes in excruciating detail – how different chemicals impact the body. The series categorized chemicals under five main groups, according to their effect on humans: asphyxiation agents, tear agents, sneezing agents, rotting agents, and poisons. Meng also wrote about efforts to find ways to protect against or mitigate the effects of these substances, using other chemicals as filters. Although the author did not condemn the discovery of toxins or experiments in synthesizing chemicals, he stressed that the process of experimentation and mass production was the reason chemicals have become more potent and deadly.[337]

The arms race between different countries resulted in stronger harmful substances deployed in more effectively destructive ways, but it also brought about solutions. Experiments were used to find out what chemicals could protect against commonly used toxins, resulting in filters and gas masks. However, this protection was not available or affordable to everyone. The last two articles in Meng's series discussed filtering systems and gas masks and compared the prices of different masks. Full gas masks, which protect the entire face and eyes, cost between 15 and 20 *yuan*, a price that put it out of reach for most people, including urbanites in low-level skilled positions. Simple filters and goggles could cost between 5 and 8 *yuan*, which was much more affordable, but still prohibitive for laborers or peasants.[338] Even if cost was not a concern, gas masks were in short supply. Many soldiers in the Nationalist army were not supplied with gas masks, and those who were often had low quality ones.[339] The government could not supply its citizens with effective

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[337] Meng Xinru 孟心如, "Huaxue zhan er" 化學戰二 [Chemical Warfare Part Two], *Kexue huabao* 3 no. 24, 1936, 964.
[338] Meng Xinru, "Huaxue zhan – lüdu jiexie" 化學戰 - 濾毒機械 [Chemical Warfare – Filtering Machines], *Kexue huabao* 5 no.1, 1937, 13-14.
[339] Grunden, "No Retaliation in Kind," 265.

gas masks. Meng suggested home-made solutions, such as holding a piece of cloth soaked with sodium thiosulphate, used to treat cyanide poisoning.[340]

The best solutions offered by science, namely gas masks and shelters, were not available to most Chinese urban residents in the same way they were available to those in Paris, London, and Berlin. Technological development drove the production of gas masks, but making them available, Meng Xinru wrote, was beyond the purview of scientists. He urged the government and the business sector to work together to provide proper protection for Chinese citizens.[341] While scientific developments could create solutions, Meng recognized the limitations of economic and logistical realities.

A Benevolent Weapon: The Atomic Bomb

In sharp contrast to the somber writing on chemical warfare and other weapons, reports on the atomic bomb in *Kexue huabao* were colored by post-war celebration. The journal carried articles describing the principles of atomic fission, the history of the bomb's development and its mechanism, and the physics and chemistry that was involved in its production. The journal represented the atomic bomb not as a deadly, destructive, weapon, but as a positive achievement, the result of scientific cooperation, and the reason the war had ended. The destruction that it brought to Hiroshima and Nagasaki were mentioned, but in a matter-of-fact way that did not display much empathy to civilian victims. The images in these articles portrayed the research it involved as well as illustration of the atom's structure.

The issue published in October 1945, a few months after the August bombing of Hiroshima and Nagaski, carried several articles on atomic fission and the atomic bomb. One of the articles,

[340] Meng, "Huaxue zhan," 14.
[341] Meng, "Huaxue zhan," 14.

titled “A History of Atom Splitting,” characterized the bomb as a transnational endeavor and a scientific achievement to be celebrated.[342] The author, Chen Yuesheng 陳嶽生 (fl. 1929 – 1949), was the journal’s new managing editor. The two atomic bombs dropped by the Americans, he wrote, are to be thanked for “laying the foundation for world peace” and “ridding the world of the specter of destruction.”[343] The article described the history of scientific discoveries and experiments which led to the eventual splitting of the atom and the atomic bomb, starting from the discovery of radiation by Marie Curie. His history emphasized the role of different nations, scientists old and young, and the hours of research and immense resources behind the creation of the bomb. His account portrayed it as a successful example of international collaboration.

Most of the articles on the atomic bomb in *Kexue huabao* similarly focused on the process of scientific research behind it. Another article by Chen Yuesheng discussed experiments on the atomic bomb. It contained images comparing the shape and characteristics of the mushroom clouds forming after the bomb exploded in the experimental site in New Mexico and in actual deployment in Hiroshima and Nagasaki.[344] Other images in the article were from experiments conducted in the Marshall Islands in 1946. Commenting on one picture of a smoke cloud above the water, the author wrote that some people liken it to a beautiful woman’s hair.[345] The photographs depicted explosions in the sky or over empty land but did not reveal any of the destruction of deploying the bombs or forcibly removing populations to conduct these experiments.

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[342] Chen Yuesheng 陳嶽生, “Hongzha yuanzi su congtou” 轟炸原子溯從頭 [The History of Splitting the Atom], *kexue huabao* 12 no.1, 1945, 19-23.
[343] Chen Yueseng, “Hongzha yuanzi,” 20.
[344] Chen Yuesheng, “Yuanzi zhadan shiyan” 原子炸彈實驗 [Experiments on the Atomic Bomb], *Kexue huabao* 12 no.9, 1946, 452.
[345] Chen, “Yuanzi zhadan,” 453.

The authors writing about the atomic bomb in the immediate aftermath of its detonation were most likely not aware of the extent of the damage it caused. There was evidence of the long-term damage from radiation in the experiments that were reported on in *Kexue huabao.*[346] Henrietta Harrison notes that in the first days after the bombings, the Chinese media did not report on it as a monumental event. There were no immediate reports on the experience of the victims, and it was not clear to readers at the time how these bombs were different from other aerial attacks.[347] In this context, it is easy to understand that Chinese citizens who lived through years of Japanese air-raids may not have been sympathetic to the enemy's plight. However, the journal's writers clearly understood the scientific principles of an atomic bomb which made it qualitatively different from the incendiary ones used previously.

Rumors are More Harmful than Bombs

In other aspects of warfare, having scientific knowledge was seen as a method of defense. This was the case in editorials that discussed the harmful effects of rumors during wartime. One editorial from August 1938 asked whether biological warfare was probable.[348] The author, Yang Yingchu 楊應雛, recounted different rumors that had been circulating about weaponizing bacteria, such as a report of Germany stockpiling disease-carrying rats, or releasing bacteria into drinking water repositories. Yang explained that many of these scenarios may be possible in theory, but they were far from applicable. Dropping glass bottles or bombs full of bacteria would probably

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[346] Chen Yuesheng, "Yuanzi zhadan zaocheng de fangshexing wuzhi" [Radioactivity Created by the Atomic Bomb], *Kexue huabao* 12 no.3, 1945, 122.

[347] Henrietta Harrison, "Popular Responses to the Atomic Bomb in China, 1945-1955," *Past and Present* 8, (2013): 98-99.

[348] Yang Yingchu 楊應雛, "Du jun dan guoneng shixian ma?" 毒菌彈果能實現嗎 [Is a Poisonous Bacteria Bomb Possible?], *Kexue huabao* 5 no. 12, 1938, 1.

have little impact, and most public health systems in civilized nations (*wenming guojia* 文明國家) could offer some measures to mitigate outbreaks from disease-carrying pests or cholera.[349]

These bacterial weapons were not realistic, Yang wrote, but the rumors themselves are a powerful weapon used by the enemy to terrorize the population. Psychological weapons, according to Yang, were more harmful than bombs and bacteria. Yang identified "citizens with no scientific knowledge" (*wu kexue zhishi de renmin* 無科學知識的人民) as the targets of psychological warfare.[350] He called on the government to dispel rumors and help people understand the real situation. This, he concluded, was just as important as defending against air-strikes.

Another cause of anxiety were rumors of a "death ray" (*si guang* 死光), an electro-magnetic wave, or a form of concentrated radiation, that was strong enough to short-circuit electricity, potentially causing cars, ships, and planes to malfunction, collide, or explode. An author writing under the pseudonym Jing Qing 鏡清 (literally meaning mirroring clarity), criticized journalists with no knowledge of science who propagated rumors of a radio-wave based "death ray" (*zhiming shexian* 致命射線) ostensibly developed by inventor Gugliemo Marconi before his death. According to the writer, Marconi's experiments in developing a radio-based weapons were unsuccessful and resulted only in killing a mouse that was three inches away.[351]

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[349] Mary Augusta Brazelton argues that even outside the metropoles of Beijing and Shanghai, cities in China's southwest offered some infrastructure of public health – including vaccination against cholera – to the public. Although intake of vaccines was low, and outbreaks still occurred frequently, it was nevertheless available. Mary Augusta Brazelton, *Mass Vaccination: Citizens' Bodies and State Power in Modern China* (Ithaca: Cornell University Press, 2019), 33.

[350] Yang Yingchu, "Du jun dan," 1.

[351] Jing Qing 鏡清, "Guanyu shexian de hushuo" 關於射線的胡說 [Death Ray Nonesense], *Kexue huabao* 5 no. 10, 1938, 1

These were nothing but unfounded rumors, and the author urged the media not to perpetuate them.[352]

But the threat of the so-called death ray persisted and continued to circulate in news outlets globally. In Spring 1939, Hitler claimed in a speech that Germany had developed a new weapon that they would soon showcase. Italian officials also claimed that Marconi had successfully experimented with stopping traffic using an electro-magnetic wave. Cao Zhongyuan, who studied electric engineering in Marconi's London school, explained that these reports were mere propaganda.[353] As a Marconi expert, Cao knew the details of his experiments. He enlisted "pure electric science" (*chuncui dianxue* 純粹電學) to ascertain whether there was any truth behind the news reports and to allay the public's fears.[354] He explained the principles of rays (*guang* 光) and the nature of death ray experiments to date. Nikola Tesla, Cao wrote, was the first to invent "death waves" (*si bo* 死波), referring to experiments the inventor conducted in 1898 with a high-voltage conductor. This conductor, according to Cao, caused major interruptions and short-circuited electric power in the area. However, Marconi also tried experimenting with similar rays, only to admit he could not conclude that electro-magnetic waves could produce a high enough signal. Therefore, Cao argued that a wave strong enough to destroy an enemy army's firearms was not realistic. He concluded that death rays were real, but they were still only "games of experiment" and not applicable in battles. By applying scientific knowledge, Cao concluded, we can see claims of new weapons made by Germany, Japan, and Italy for what they were: exaggerations meant to spread fear.[355]

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[352] Jing Qing "Guanyu shexian," 1.
[353] Cao Zhongyuan 曹仲淵, "Si guang?" 死光 [Death Rays?], *Kexue huabao* 7 no.11, 1941, 621-622.
[354] Cao, "Si guang," 621.
[355] Cao, "Si guang," 622.

Science brought about the development of new weapons, but it was not an uncontrollable force. Writers such as Yang Yingchu and Cao Zhongyuan tried to convince readers that science could benefit humanity even during a global war, and that scientific knowledge could be used against weapons: it could be used to dispel rumors, to assess the real threat level of different weapons, and to defend against weapons. Meng Xinru's articles on chemical warfare showed that most chemical substances used in warfare had a corresponding substance that mitigated their harm, even if not all protective equipment was available to all.

An editorial by Yang Yingchu published in July 1938 made a similar point regarding air-raids. In the editorial, titled "Can Science Prevent Air-Raids?" (Kexue neng zuzhi kongxi hu? 科學能阻止空襲乎?), Yang stated that while war technology developed rapidly in the inter-war period, defense technology developed even faster.[356] Most people, he wrote, were skeptical about the usefulness of air-raid drills and defense training. They believe rumors of poisons that can penetrate gas masks and fighter jets that go undetected. Once again, science was called on to set the record straight. Yang made the argument that sufficient fortification using underground shelters, anti-aircraft missiles, and air-raid alarms could render these attacks useless in securing victory. Media reports in China and in Europe predicted that air-raids would annihilate entire cities.[357] Yang's editorial argued that these predictions did not materialize because of the developments of new technologies. Even cities which did not have the newest air-raid defense equipment, such as Nanjing and Wuhan, had successfully taken down enemy jets. According to Yang, this was evidence that air-raids were not as destructive as the media painted them out to be. Science could

[356] Yang Yingchu 楊應雛, "Kexue neng zuzhi kongxi hu?" 科學能阻止空襲乎 [Can Science Prevent Air-raids?], *Kexue huabao* 5 no. 11, 1938, 1.
[357] Helen Jones, *British Civilians in the Front Line: Air Raids, Productivity, and Wartime Culture, 1939-45* (Manchester: Manchester University Press, 2006), 56.

not prevent air-raids, he concluded, but it had already given humanity (*yu renlei* 予人類) sufficient methods of defense.[358]

But Yang's assessment of the level of preparation of cities in China was optimistic, and he did not consider that these measures did little to alleviate the fears of the population, both in well prepared European capitals and in less equipped Chinese cities. In Britain, both the public and politicians worried that air raids would render civilian population completely vulnerable, despite security measures.[359] In Chongqing, the wartime seat of the Republican government, public air raid shelters were underequipped and not properly constructed or maintained, to a degree that people were reluctant to use them for fear of being trapped inside. Moreover, even at the height of Japanese air raids on the city, the public shelters could only accommodate 65 percent of the city's population.[360] The technological ability to detect incoming fighter jets and construct shelters did not translate into a sense of security amongst civilians.

Time had proven Yang Yingchu wrong. After his editorial urging readers to not feel terrorized by air raids was published, Japanese troops overtook Wuhan, and from late 1938 aerial bombings of Chongqing became more frequent. They may not have obliterated the city or given Japan immediate victory, but they took a significant toll on the population.[361] Yang changed his position on air raids. He still maintained that aerial bombing alone could not guarantee victory, and he still had confidence in defense measures. But as these measures were being put to the test in China and

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358 Yang Yingchu, "Kexue neng?", 1.

359 For an analysis of the public concerns over air-raids in Britain, see Susan R. Grayzel, *At Home and under Fire: Air Raids and Culture in Britain from the Great War to the Blitz* (Cambridge: Cambridge University Press, 2012), 200-214.

360 Chang Jui-te, "Bombs Don't Discriminate? Class, Gender, and Ethnicity in the Air-Raid Shelter Experience of the Wartime Chongqing Population," in *Beyond Suffering: Recounting War in Modern China*, James Flath and Norman Smith, eds. (Vancouver: University of British Columbia Press, 2011), 66-68.

361 Rana Mitter, *Forgotten Ally: China's World War II, 1937- 1945* (Boston: Houghton Mifflin Harcourt, 2013), 173-182.

around the world, the shortcomings of sirens, the lack of availability of shelters, and the growing loss of life and destruction from continuous bombardment, had become evident. In an April 1939 article entitled "City Dwellers' Menace from the Sky – Incendiary Bombs" (Shimin de kongzhong weixie – shaoyidan 市民的空中威脅 – 燒夷彈) Yang focused on the very harmful impact of incendiary bombs.[362] He first explained their characteristics and mechanism. The most common bomb was made of magnesium and weighed two pounds. When detonated, it erupted in white-hot flames and sent a shower of burning metallic sparks. The heat from the flames could ignite anything in a five to seven foot radius, and the sparks extended even further. The fires caused by these bombs could not be easily put out with water, but required large amounts of sand.[363]

The harrowing description was not followed by any comforting words or effective solutions to defend against such bombs. Yang presented a few different precautions that could potentially reduce their impact, but not much more than that. Some measures were low investment and accessible, such as stuffing doors and windows with damp towels. Other suggestions, like digging a bomb shelter, were far too complex, requiring labor, materials, and time that most readers did not have access to.[364] Even putting out fires using sand required specialized equipment such as protective goggles and a metal hat, on top of large amounts of sand. The article was illustrated with images from a foreign magazine depicting a western-style, two story villa with a car garage and an expansive garden. The images of this elite, foreign, well-fortified household only reinforced how unattainable bomb protection measures were for Chinese citizens.

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362 Yang Yingchu 楊應雛, "Shimin de kongzhong weixie – shaoyidan" 市民的空中威脅 – 燒夷彈 [City Dwellers' Menace from the Sky – Incendiary Bombs], *Kexue huabao* 5 no. 20, 1939, 798.
363 Yang Yingchu, "Shimin," 799.
364 Yang Yingchu, "Shimin," 799.

The cover of the issue featured an illustration of fighter jets dropping bombs on an inhabited area, smoke columns rising from the ground indicating spots where bombs have hit and caused fires (figure 3.3). The image, attributed to a Mr. Qi 琪君, combined the airplane illustration from a foreign magazine with the artist's own rendering of the landscape the planes were attacking, evoking a Chinese landscape of urban areas (closest to the mountain, figure 3.3) amid parcellated agricultural plots. The cover's portrayal was not of a well-defended city, but focused on the titular "menace," the airplanes carrying bombs to be dropped on civilian populations.

The discussion of weapons in *Kexue huabao* reveals a tension between anxiety over new technologies and a belief in the power of science to offer protection and defense. Images tended to highlight the anxiety, depicting menacing machines and the damage they cause. The causes for concern ranged from the improbable and imagined, such as death-rays and hybrid tanks, to actual and realistic, such as bio-chemical warfare and improved fighter jets for aerial attacks. These anxieties were not limited to Chinese readers: fears of death rays, bio-chemical warfare, and new bombers dropping explosives from the sky were common in news reports, government directives, and popular media in European cities that became wartime targets.[365]

Science and technological development were a double-edged sword, and the writers of *Kexue huabao* engaged with both sides. They described the destruction and terror that new weapons – products of scientific discoveries – brought on civilian populations. But the same process of experiment and discovery also produced mechanism of defense, from the home-made "gas masks" of cloth and baking soda to air raid sirens and anti-aircraft missiles. Scientific

[365] Jones, *British Civilians in the Front Line*, 56-58; Grayzel, *At Home and under Fire*, ch. 7.

knowledge itself was also presented as a weapon of defense, when used to educate the population so they would not fall prey to enemy propaganda and rumors.

Science is not to Blame for Modern Warfare

The war had started to make dents in the belief that science alone had the power to transform society. Writers in the magazine increasingly pointed to the role of politics, government, and people, in the ways that science was used. Specifically in editorials, there was a growing distinction between science and its application, and an attempt to separate scientists and their work from the realm of politics. Technology itself was not condemned, but rather its abuse at the hands of military leaders and politicians. Of course, mobilizing science to *defend* the nation – as the magazine's publisher suggested early in the war – was not depicted as negative. Military applications of science were bad when they were used by the enemy.

Despite the direct link between scientific developments and destructive weapons explored in the magazine, *Kexue huabao*'s stance was that science was not responsible for war. Science was still seen as an inherently benevolent force even though it was being used to develop weapons. Most of those who wrote on science and war had an ambivalent approach. They acknowledged the role of science in the violence and destruction brough on by war, but they also maintained that it was not a result of scientific development. On the edges of the spectrum, some writers were deeply pessimistic and questioned the power of science to change society, and some held a utopian view, believing that what the world needed was further technological development.

Some common elements were expressed in the different editorials on this topic. All writers argued that there was a difference between science, a method of creating knowledge, and the application of its results. While the former was under the purview of scientists, implementing the products of research was the purview of politicians and the military. Of course, this view contradicted the editors' stance about the need for all those involved in science to make themselves available to the government's needs. It also occluded the fact that scientists were employed by governments to conduct research on weapons. But this distinction was used to defend science from those who saw it as the handmaid of belligerence. Writers held a naively optimistic view of scientists as inherently moral, truth-seeking, and peace-loving people. The goal of scientific research was not to create weapons but to uncover the principles of nature. Scientists were only motivated by a pure desire for knowledge and truth, a claim that was repeated in several articles. Science could be used by "bad people" for the purpose of war, but scientists were "good people" and were not the reason war existed.

One of the early pieces on the topic of science and war was the editorial of the special issue dedicated to military affairs published in April 1936. The editorial, titled "War and Science" (Kexue he zhanzheng 科學和戰爭), was penned by publisher and editor in chief Yang Xiaoshu. It charted the main points in the debate that would continuously figure in other writings in the journal from 1937 to the end of the war. The first point was a distinction between science and its application and uses. Yang wrote that war had been a constant feature in human society, and science had always been applied for battle.[366] He acknowledged that the dangers of contemporary warfare, such as air-raids and chemical weapons were the result of modern scientific development (*xiandai kexue fazhan souzhi* 現代科學發展所致).[367] But science, he insisted, did not appear because of war, and did not exist solely for war. Science can be used for many things, military technology being only one among them. The second point was the idea of the scientist's moral character. Yang claimed that scientists were motivated by a search for truth (*qiu zhenli* 求真理)

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[366] Yang Xiaoshu 楊孝述, "Zhanzheng he kexue" 戰爭和科學 [War and Science], *Kexue huabao*, 3 no.18, 1936, 701.
[367] Yang, "Zhanzheng he kexue," 701.

and were not in the business of warmongering. Their efforts to discover the principles of nature were the basis upon which civilization advanced. Therefore, although "modern war is scientific," the opposite assertion – that modern science is war-oriented, was not true.

The third point in the article revealed that Yang was not so naïve as to ignore the entanglement of science and politics. Modern wars, Yang wrote, were battles of science fought between two nations. Even technologies relating to non-military affairs, such as grain production and distribution, become a factor determining a country's success or failure in battle. That was the reason that the use of science for warfare expanded.[368] It was imperative for a nation to continuously develop its production, but during war it became a matter of survival. One of the examples Yang used was Germany during the First World War. Its developed industry and science allowed the country to declare war, and although ultimately defeated, Germany was able to persevere for several years and revive itself after losing the war. On the other hand, in the Italian-Ethiopian war which started in 1935, the Ethiopians had the odds in their favor. Their people's bravery is well-known, their army is well financed, and they had a geographic advantage. They have been able to maintain their lines, but now they are starting to lose battles. This, according to Yang, was because Ethiopia was not scientific (*wu kexue* 無科學).[369]

War was perhaps not the main motivation for scientific research, but it was imperative for a nation to develop science and industry to survive during war. The ambivalence in this article stems from Yang's assertion that scientists are not interested in war, alongside the realistic need he describes for a nation to develop its industrial and military capacities which rely on science. The tone of Yang's article did not encourage or celebrate war and acknowledged the deadliness of

[368] Yang, "Zhanzheng he kexue," 701.
[369] Yang, "Zhanzheng he kexue," 701.

new technologies. However, it also maintained that national survival depended on science and its application in wartime.

Yang Xiaoshu edited and translated a different piece which presented a less ambivalent position. It was an excerpt from a speech made by the president of the British Association for the Advancement of Science, Robert John Strutt, the Lord Rayleigh (1875-1947). Yang chose to translate only the last part of the speech, which related to the question of science and war. He gave the article the title "Science is not to Blame for Modern Warfare" (Xiandai zhanzheng fei kexue zi zui 現代戰爭非科學之罪), and shortened it significantly, condensing the argument and eliminating several examples that were specific to British history. [370]

The original speech was given by Strutt in August 1938 as part of the presidential address for the British Association for the Advancement of Science (now the British Science Association). The main part of the address was on the topic of optics and vision, but Strutt concluded with his thoughts on science and warfare. Although this was not the focus of the address, the relevance of the topic garnered responses in the scientific community around the world. The speech was reported on in newspapers in England, India, and in English language newspapers in China such as the *North China Daily News*.[371]

Yang's translation started not with the original opening paragraph, but with the second paragraph in which Strutt claimed that "ordinary people" consider science to be the root of all trouble. Yang created an equivalence between lay people in China and in England, where the

[370] Yang Xiaoshu 楊孝述, "Xiandai zhanzheng fei kexue zhi zui" 現代戰爭非科學之罪 [Science is Not to Blame for Modern Warfare], *Kexue huabao* 5 no.15, 1938, 1.
[371] Robert Strutt, "The Presidential Address," *Current Science* 7 no.3, 1938, 149-160. The latter part of the address was printed in its entirety in the *North China Daily News*: "Science and Warfare," *North China Daily News*, September 15th, 1938, 2. It was also reported on in the *Shanghai Times*: "Science and Warfare," *Shanghai Times* September 7th, 1938, 10.

speech was originally delivered. Lay people in both nations were construed as ignorant of the principles of science. Transcending national boundaries, the translation created a divide between those who understood science and those who did not. Upholding this distinction positioned *Kexue huabao* as an authority equivalent to that of the British Association for the Advancement of Science. The choice to translate Strutt's speech also indicates that the editors of the journal saw their readers as part of a global community of popular science audiences.

According to Strutt, people thought science was responsible for war because they did not understand the aim of science, which is to "clarify the truth" (*chanming zhenli* 闡明真理 in Yang's translation, echoing his own words about scientists being interested only in uncovering the truth.) People also misunderstood the process of experiment, specifically that scientists do not know in advance what results an experiment will yield. In the speech and in Yang's translation, science work was cast as seeking objective truths about nature and materials. Scientists are driven only by a search for facts and comply with the experimental method, and are generally ignorant of, or at least not responsible for, the later applications of their work.[372]

Harmful, toxic substances were the result of scientific experiment, but they were not developed specifically to cause harm. Strutt used the example of mustard gas: he claimed that when it was first recorded, it was not considered an important chemical compound. Mustard gas only had a short entry in an 1894 dictionary of chemistry, and shared the page with 16 other substances, none of which were of much significance, in his estimation. It was unreasonable to condemn those who experimented with different chemical compounds, because some of those substances proved to be beneficial, like chloroform which eases pain. When conducting

[372] Yang, "Xiandai zhanzheng," 1.

experiments, a scientist does not know what the result will be, nor is he aware of the potential uses of the substance.

Yang Xiaoshu included the mustard gas example but shortened the argument to include only the part about the substance not being important at the time it was discovered. He also did not include the description of the substance, which Strutt quoted from the 1894 chemical dictionary: "oil, very poisonous and violently inflames the skin."[373] Yang summarized the argument by asserting that the use of mustard gas in warfare was completely accidental (*ji ouran de shi* 極偶然的事), not the intentional goal of its producers.[374] The other examples Yang chose to translate and include in his article were in a similar vein, to support the argument that warfare application was not the chief motivating factor behind the discovery of different substances or the invention of technologies such as flight.

Some in the scientific community disagreed with Strutt's point of view. An anonymous writer in the Bangalore-based *Current Science* magazine, for example, opposed the suggestion that scientists did not know their discoveries would be used for war, writing that it was unreasonable to think that those who dealt with explosive compounds and poisonous gases were "innocent of the consequences of the products of their research."[375] Strutt's address exonerated scientists from responsibility for developing weapons, and went so far as to almost deny the relationship between scientific development and military capability. This was different from the more balanced and ambivalent view of science in relation to war which Yang articulated in his own article. Yang's decision to translate and publish the address should not be seen as a blanket support for the views

[373] Strutt, "The Presidential Address," 159.
[374] Yang, "Xiandai zhanzheng," 1.
[375] "Vision and War," *Current Science* 7 no.4, 1938, 163.

expressed in it. It was in part a way to expose local readers to trans-national perspectives on a question of great significance to Chinese audiences.

A different approach to the responsibility of scientists was demonstrated in an editorial by Yang Yingchu, entitled “Is Science Powerless?” (Kexue he neng weili zai 科學何能為力哉).[376] Yang Yingchu had authored two editorials on the probability of poisonous gas bombs and on defense against air-raids. In those articles he confidently declared that science had the power to defend against air-raids, and to protect from an even more harmful weapon – baseless rumors. Yet in this editorial there was much less conviction in the redeeming power of science. The main difference between this editorial and the previous ones was in subject matter. Yang’s writing on air-raids and gas bombs dealt with specific technologies. But in “Is Science Powerless?” he ruminated on the social role of scientists and the general causes of war. Yang echoed Yang Xiaoshu’s view of the moral character of scientists, stating that they were the most peace-loving among humans. He also maintained the distinction between science and application to an even greater degree. The great contributions scientists made to humanity were being “misused and sullied” (*wuyong er wuzi* 誤用而污漬), discoveries and inventions meant to bring enjoyment and peace were being used for destruction.[377] The editorial blamed war not on science but on human psychology – it was human beings’ desire for power and possession that created warfare. Science did not create dictators, Yang wrote, but it helped them extend their domination over larger areas and more people.

[376] Yang Yingchu 楊應雛, “Kexue he neng weili zai” 科學何能為力哉 [Is Science Powerless?], *Kexue huabao* 5 no.10, 1938, 1.
[377] Yang, “Kexue he neng weili,” 1.

Yang Yingchu, like other writers, made a distinction between the work of scientists and its application, or misapplication, for war. However, unlike Strutt's view, he believed that scientists needed to be concerned with how to remedy the situation. The last paragraphs of "Is Science Powerless?" considered several solutions to new inventions being used for harmful purposes, such as a committee that would restrict research on certain materials. However, he quickly dismissed the feasibility of these measures because no country would put itself at a military disadvantage.

Ultimately, Yang Yingchu believed the problem was one of human nature. Scientists can do little to prevent the power-hungry from using the fruits of the labor. Furthermore, Yang argued that scientists were "an independent kind" (*duli de yi zhong* 獨立的一種), and the least interested in leadership, and so the solution would not come from them.[378] The answer, then, was that there was no solution. Not all problems in the world could be solved, Yang wrote. Ending on an even more pessimistic note, he predicted that future generations would suffer just as much as our ancestors did. It is easier to move mountains than to change human nature, Yang wrote, and considering how far the human desire for power has already gone, can science do something about it? Yang's approach was remarkable not just because of its pessimism, which was probably shared by other writers as the war progressed. It was one of the few articles suggesting there were some problems that science could not answer. The provocative question in the title asked readers to consider the limitations of science, instead of its possibilities.

Pointing out the problem, deficits, or limits of science was not common on the pages of *Kexue huabao*. Even when discussing the shortcomings of technologies, the narrative mostly maintained that more research and development could compensate for the problems. An editorial

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[378] Yang, "Kexue he neng weili," 1.

discussing the results of industrialization pointed out that people should not mistakenly assume science was only beneficial and not harmful. The author described a few problems caused by technological development related to industrialization, such as over-populated cities covered in smog and dust, unhygienic living conditions, and foods that had no nutrients because they were transported from afar or were “scientifically produced.”[379] However, the author’s conclusion was that continuous development of science has solved some of these problems, and would ultimately make the solutions affordable to all.

This utopian view of scientific development was taken even further in an editorial on traffic safety. The author opened by saying that wars were not the result of scientific development, but the result of science not being developed enough. Contemporary civilization has not yet shed its barbaric nature (*yeman shouxing* 野蠻獸性), but one day in the future people will realize that war brings only harm and no benefit.[380] Traffic safety, the topic of the editorial, demonstrated this logic: as technological developments in safety measure progressed, the number or road casualties declined. The author’s belief in this kind of science-utopianism was an extreme instance of *Kexue huabao*’s narrative that scientific development was a desirable thing that would eventually benefit mankind.

These articles articulated two ways of understanding science: one in its social role and one as the basis of technology. As the latter, science offered hope: new weapons were created but new defense methods were also evolving in step. Inventions and technologies created problems, but continuous research offered solutions. The deeper problem which writers such as Yang Yingchu

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379 Xin jun 心君, “Kexue yingyong zhi liubi” 科學應用之流弊 [The Harm of Applied Science], *Kexue huabao* 7 no.4, 1940, 1.
380 Liang Xia 梁廈, “Jiaotong anquan” 交通安全 [Traffic safety], *Kexue huabao* 6 no.1, 1939, 1.

revealed was science's failure as a force to change society. The hope that scientific progress would bring about "civilization" (*wenming* 文明) and would lead humans away from what the author of the traffic safety piece saw as our "barbaric" nature, was shattered in the face of continued imperial aggression and the second world war. Most authors were optimistic about science providing solutions against new weapons, and in general, the magazine maintained the position that science was inherently "good". However, pessimism crept in during the war, in the form of recognizing science's limits. Authors like Yang Yingchu questioned whether science could live up to the expectations its Chinese proponents had for it.

Conclusion

Despite the dislocation, violence, and financial and personal hardship of the eight-year war, *Kexue huabao* continued publishing and remained, in many aspects, the same journal it was before the war. The question of science as universal as opposed to science as a tool for national strengthening gained an additional layer of urgency, but both sides were still represented in the journal. The journal's universalist approach was in part a result of its reliance on foreign publications to supply images for the articles. But it was also a central part of how the publisher and editors viewed science: as an inherently trans-national endeavor that relied on connection and exchange between different nations. With the outbreak of war, *Kexue huabao* emphasized the role of scientists and educators in national defense, and called on them to work with the government on projects that were needed for immediate needs. Unsurprisingly, utilizing science for national defense was promoted during this time, and was seen as a legitimate and patriotic pursuit.

A new set of questions at this time pushed these science advocates to consider larger questions about the role of science in society. Although some authors were inclined to admit that science was not omnipotent, and could not fix any and all problems, the general standpoint was that science itself was objective and neutral – it was a system of creating knowledge. The magazine's editorials portrayed scientists as inherently "good" and moral people, motivated only by a desire for truth. This notion resonates with the Confucian idea of learning as a form of self-cultivation, and may be part of the reason the writers of *Kexue huabao* exonerated scientists. Another way for science to remain unsullied was the separation between science and its application. Conducting experiments was not a bad thing, but the use of the products of science for war was bad. Interestingly, using science to defend against weapons was also characterized as a reason that science was not to blame for war. This position was one that was easier for Chinese scientists to adopt, since they did not have the resources and institutional relationship with the military to develop weapons, and not on a scale parallel to that of Japan, Germany, or Britain.

The debate on the nature of science and its use during war was happening in Britain, India, and other countries involved in the war. Anxieties over the same war technologies were shared by people in London, in Madrid, and in Shanghai. *Kexue huabao* was bringing this conversation to the Chinese reader, and staking its own claim in it.

Chapter 4: Readers as Lay Science Practitioners

Introduction

The first issue published after the end of the second world war was a double celebration. Published in October 1945, it commemorated the defeat of Japan and the victory of the allies, as well as the Republic's National day. The cover of the issue featured an image of Chiang Kai-shek with the caption "without science, there is no national defense; without national defense, there is no nation" (Figure 4.1). Chiang's image, dressed in a military uniform and leaning on a sword, was superimposed on a red-tinted collage depicting different technologies and scientific inventions. These included a factory, a radio tower, and an illustration of two men in a laboratory, among others. In the middle of the collage, parallel to Chiang's head, was the slogan "the ultimate victory is in scientific rebuilding" (*zuihou shengli kexue jianshe* 最後勝利科學建設), indicating the importance of science for the nation.

Figure 4.1: Cover, *Kexue huabao* vol. 12 no.1, 1945.

The cover may have been a show of support for, and endorsement of, the Nationalist party (Guomindang 國民黨), but inside the journal, writers and editors expressed competing views of how science popularization should be carried out in post war China. The Second World War was over, but China was far from having peace restored. The country was still largely in chaos. Transportation was disrupted due to destruction of infrastructure. Millions of refugees who fled westward were trying to make their way home, if home still existed.[381] On top of that, the conflict between the Nationalist party and the Communist party, which was somewhat subdued during the Japanese occupation, was now a full-fledged civil war. The Republican government attempted to focus on rebuilding (*jianshe* 建設) through an ambitious plan for intensifying domestic industry and building infrastructure, but it was saddled with post-war demobilizing and armed conflict with communist party forces.

Kexue huabao managed to stay in print during the war years, but suffered financial losses due to lack of advertisements and a sharp decline in its print run, which decreased to several thousand copies per issue from the previous 10,000.[382] The distribution network was severely disrupted because of the war, as was the postal service. The mass migration following the Japanese occupation of coastal cities meant that many subscribers moved, resulting in disarray in the management of subscriptions.[383] Throughout 1946 and 1947, the publisher sought to increase subscription numbers in order to increase the print run, offering not only reduced prices, but gifting

[381] For refugee numbers and a discussion of post-war conditions, see Diana Lary, *The Chinese People at War: Human Suffering and Social Transformation, 1937–1945*, New Approaches to Asian History (Cambridge: Cambridge University Press, 2010),169-174.
[382] Between 1941 and 1945, the journal printed between 3000 to 5000 copies. "Kexue huabao yuekan shengqing dengji shu" 科學畫報月刊申請登記書 [*Kexue huabao* journal registration form], November 1945. SMA Q-16-12-82-58. See also Cheng Shengbo and Rao Zhonghua 成繩伯 饒忠華, "Kexue huabao wushinian" 科學畫報五十年 [Fifty Years of *Kexue hubao*], *Zhonguo keji shiliao* no.4 (1983): 24-25.
[383] "Ben bao quanguo dinghu gongjian" 本報全國定戶公鑒 [Announcement to our Subscribers Nation-wide], *Kexue huabao* 13 no.2, 1947, x-17.

books and commemorative issues.[384] Even though the war was over, there was work to be done to re-establish the magazine's finances and readership. In this context, the publisher and editors began to re-assess what science popularization meant to them: what knowledge they wanted to disseminate, and who their target audience was.

Two sets of concepts defined the discussion of the magazine's role: the first was useful or applied science (*yingyong* 應用) in contrast to theoretical science (*lilun* 理論, sometimes called "basic" *jiben* 基本). These terms came from debates amongst professional scientists and the government on the kinds of research that should be funded, and were particularly urgent during the war, when resources were scarce. In the realm of popular science, the debate on the kinds of knowledge needed was tied to intended readership, and whether the journal should favor broad and popular (*puji* 普及) knowledge or specialized knowledge (*shenru* 深入).[385]

Applied, theoretical, broad, and specialized were not mutually exclusive, and do not offer symmetry in the kind of readers they implied. For example, pieces coded as applied science, such as chemistry experiments or articles on new models of airplanes often assumed readers knew basic terminology and principles of the specific field. "Applied," therefore, did not mean widely accessible. Conversely, "theoretical" knowledge, sometimes referred to as "basic" (*jiben* 基本) also encompassed knowledge on foundational concepts for readers who had no prior science education. Exploring the ways that these terms were used by the journal's editors reveals that rather than being set concepts, they were fluid categories that were used to appeal to different audiences and to signal different approaches to science popularization.

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[384] Advertisement, *Kexue huabao* 13 no.9, 1947.

[385] Yang Jifan 楊季璠, "Zuihou shengli zai jinhou kexe jiaoyu shang de jiaoxun" 最後勝利在今後科學教育上的教訓 [Ultimate Victory is in Implementing the Lessons of Science Education], *Kexue huabao* 12 no.1, 1945, 4-5.

From the mid-1930s and throughout the war years, the question of “pure” as opposed to “applied” scientific research was a source of tension between the Republican government and scientists, and among scientists in different fields. Both the Nationalist and Communist parties had emphasized that applicability and usefulness should be paramount considerations in determining the agenda of research projects and science education. The Nationalist party planned on training engineers and mechanics to contribute to their ambitious rebuilding plans even while fighting a civil war.[386] The Chinese Communist Party also focused on providing technical training to students at the Natural Science Institute they established in Yan’an in 1939.[387]

James Reardon-Anderson argues that during the early 1930s, professional scientists were largely opposed to the idea that the government should dictate their research agenda. This changed during the war, when scarcity of resources and pressure to increase production demanded scientists choose between theoretical research and projects that could directly address the nation’s needs.[388] Lu Yudao 盧于道, who at the time served as both on the editorial board of *Kexue huabao* and as editor of *Kexue*, accused scientists who focused on theoretical matters of ignoring their responsibility to society. But at the same time, scientists also claimed that pure and applied research were two sides of the same coin, and that both were needed.[389] Furthermore, in some fields the boundary between theoretical and useful was slippery. Grace Shen’s study of geology reveals that geologists were able to connect basic questions in their field to immediate national

[386] J. Megan Greene, “GMD Rhetoric of Science and Modernity (1927-1970),” in *Defining Modernity: Guomindang Rhetoric of New China, 1920-1970*, ed. Terry Bodenhorn (Ann Arbor: Center for Chinese Studies, University of Michigan, 2002), 231-233.
[387] James Reardon Anderson, “Science in Wartime China,” in *China’s Bitter Victory: War with Japan, 1937 – 1945,* James C. Hsiung and Steven Levine, eds. (New York: M.E Sharpe, 1992), 222.
[388] James Reardon Anderson, *The Study of Change: Chemistry in China, 1840 – 1949*, (Cambridge: Cambridge University Press, 1991), 247 – 257.
[389] Reardon Anderson, *Study of Change*, 313.

concerns.[390] She argues that the categories of pure and applied research are best understood as context-sensitive terms, and not indicators of specific scientific practices.[391]

The question of science's usefulness took on a different meaning in the context of popular science. Utility did not simply correspond with national needs, but it was also a marketing tool, a way to convince readers that science was important to their daily lives. It could also encompass a wide range of levels of knowledge, from simple household tips to more complex and technical knowledge geared towards readers who managed industrial or agricultural production. Moving from basic scientific knowledge to a focus on technical knowledge in the journal was not a result of a top-down government imperative. Rather, it reflected the new kinds of audience that the journal was targeting.

The post-war reassessing of the journal's mission resulted in a change in the intended audience of the journal, and in a changing relationship between the editors and the readers. This process began in 1947 but continued after the Chinese Communist Party came to power in 1949. In communist party histories the year 1949 is characterized as a dividing line separating "old" from "liberated" China. But in the case of *Kexue huabao*, considering the years between October 1945 and the end of 1952 as one unit allows us to identify the continuities in how the journal related to its audiences, as well as the changes made to adjust to the Socialist regime. In the past few decades, historians have reassessed the narrative of 1949 being a watershed in China's modern history.[392]

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[390] Grace Shen, *Unearthing the Nation: Modern Geology and Nationalism in Republican China* (Chicago: University of Chicago Press, 2014), 135 - 142.
[391] Grace Shen, *Unearthing the Nation*, 142.
[392] For one example, see William C. Kirby, "Continuity and Change in Modern China: Economic Planning on the Mainland and on Taiwan, 1943-1958," *The Australian Journal of Chinese Affairs*, no. 24 (1990): 122-123.

More recently, scholars have demonstrated that the early 1950s constitute a unique transitional period, in which the communist regime took an approach of accommodation and unity.[393]

The establishment of the People's Republic of China in October 1949 under the Chinese Communist Party was not an immediate and clean break for *Kexue huabao*. The transition period, which for the magazine was between 1949 and 1952, was one of swift changes alongside enduring consistencies. The journal's editorial board underwent changes after 1949, but it continued to be published by the China Science Society until the end of 1952. After that, it was transferred to a new editorial board and a new publishing house, the Shanghai Association for the Popularization of Science and Technology (Shanghai shi kexue jishu puji xiehui 上海市科學技術普及協會).

This chapter focuses on the shifting relationship between the editors and their readers from 1945 to 1952, and argues for continuity in the face of political change. Beginning in 1947, the journal shifted to cater to more educated audiences, and to a focus on applied sciences such as mechanics, engineering, and chemistry. The editors abandoned the ideal of drawing in uninitiated readers and "awakening" them to science. Instead, they dedicated the majority of the journal to a community of readers who already viewed science as an important part of their daily lives, and gave these readers a more authoritative position. This is not to say that the readership itself changed dramatically. Letters to the editor examined in chapter one suggest that many readers had facility with foreign languages and had a grasp on scientific concepts. The change in 1947 was that the editors deliberately addressed this group as its main audience, while columns and articles meant for complete novices took up much less space in the journal.

[393] Jeremy Brown and Paul Pickowicz, "The Early Years of the People's Republic of China: An Introduction." In *Dilemmas of Victory: The Early Years of the People's Republic of China*, Jeremy Brown and Paul G. Pickowitz, ed. (Cambridge, Massachusetts: Harvard University Press, 2007), 1-3.

Publishers and editors played a critical role in shaping the discourse in their publication. Sun Liying uses the term "editorial agency" to highlight how editorial practices impacted the ways that new concepts were framed for different audiences.[394] Scholarship on scientific journals in recent years has shown how interactions between editors and readers created scientific communities. The readership of *Nature* magazine, for example, was determined by the editor's choice of language, as well as the kinds of pieces they accepted for publication.[395] Bernard Lightman's work on astronomy journals in 19th century Britain demonstrates the importance of the relationship between editors and readers in creating a community of science readers outside of elite institutions.[396] Building on this work, this chapter argues that editorial practices enabled a community of readers to coalesce around the journal, and explores the kinds of readers that *Kexue huabao* attracted.

The overall editorial agenda between 1947 and 1952 was to engage audiences who had a foundation of knowledge in science. From 1947 to 1951, readers were able to participate in the journal by submitting letters, inventions, and questions that were published in dedicated columns. The change in the targeted audience, and more specifically the new pattern of interactions among the readers and between readers and editors, destabilized the previously established hierarchy in the journal that cast the editors and writers as experts and the readers as novices seeking education.

The chapter examines this changing relationship by analyzing the readers' participation in the journal. I focus on the columns where the readers' own voices – although mediated by the

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394 Sun Liying, "Engendering a Journal: Editors and Nudes in Linloon Magazine and Its Global Context," in *Women and the Periodical Press in China's Long Twentieth Century: A Space of Their Own?* Michel Hockx, Joan Judge, and Barbara Mittler, eds. (Cambridge, U.K: Cambridge University Press, 2018), 65-68.

395 Melinda Baldwin, *Making Nature: The History of a Scientific Journal* (Chicago: The University of Chicago Press, 2015), 9.

396 Bernard Lightman, "Late Victorian Astronomical Society Journals: Creating Scientific Communities on Paper," in *Science Periodicals in Nineteenth Century Britain: Constructing Scientific Communities*, Gowan Dawson et. al. eds (Chicago: The University of Chicago Press, 2020), 276.

editors – come through. This analysis reveals a group of people who I call “lay science practitioners.” These readers were not professional scientists, but they conducted experiments at home, at work, or at school. They thought about scientific questions, read books, and wanted to “do” science. Eugenia Lean emphasizes the importance of un-official spaces, such as the home and women’s magazines, to diverse audiences who engaged with new scientific knowledge in the early 20th century, when science and industry were not yet consolidated.[397] By the 1940s, China had a more stable and defined sphere of professional science. But the readers of *Kexue huabao* provide evidence of a thriving community of people who engaged with knowledge coded as science outside of institutional settings, even as the boundaries of professionalism became clearer and more entrenched.

Examining readers’ contributions to the journal also demonstrates the different motivations behind their engagement with science and *Kexue huabao*. Most readers were drawn to science because it was interesting and satisfied their intellectual curiosity. At the same time, they often tried to use it to solve specific problems that arose in their work, hobbies, or daily lives. For other readers, the journal may have provided a form of entertainment, while also keeping them abreast of the newest developments in science. Grace Shen has called for historians of science in modern China to take both utility and desire seriously. Asking *why* people in China wanted science, and how they used it, undermines the narrative that modern science spread across the globe because it was a knowledge system that was inherently superior.[398] The case of the readers of *Kexue huabao* demonstrates that desire and utility went hand in hand. Readers saw science as a tool to help them

[397] Eugenia Lean, *Vernacular Industrialism: Local Innovation and Translated Technologies in the Making of a Cosmetics Empire, 1900-1940* (New York: Columbia University Press, 2020), 8.
[398] Grace Shen, “Murky Waters: Thoughts on Desire, Utility, and the ‘Sea of Modern Science’,” *ISIS* 98 no.3 (2007): 586-587.

solve different problems. At the same time, they expressed their connection to science – and to the magazine – in affective terms.

Useful, Basic, Popular, Professional?

The same issue of *Kexue huabao* which carried the image of Chiang Kai-shek on its cover also printed an abridged copy of Chiang's ten-year plan for personnel, materials, and goods, which listed goals for production, infrastructure building, and expert training in different fields.[399] The plan was heavily focused on applied sciences. In the goals for training personnel, the table listed 13 fields and the target number of university graduates in each field. All the fields were applied sciences, such as civil engineering, electrical engineering, metallurgy, industrial chemistry, aviation, and medicine. The last item on the list combined humanities, law, economics, and "others" into one category, with a total goal of 31,000 graduates.[400] Meanwhile, there were no specific targets for specialized physicists, biologists, meteorologists, or similar scientific disciplines. The plan also listed goals for producing or procuring infrastructure and machinery, such as laying train tracks and electric cables, producing 44,000 combined passenger-cargo freights, 18,000,000 radio sets, and 96,000 cotton looms.[401]

Despite the outward display of accord with the Nationalist government in the journal's cover and printing the ten-year plan, not all editors endorsed the government's view on how to use science. Chen Yuesheng 陳嶽生 who was the managing editor from 1945 to 1946, added a note at the end of the ten-year plan undermining its message. Chen wrote that while this plan should serve as a reference point for educators, an important aspect of scientizing the nation was disseminating

[399] "Jiang weiyuanzhang shinian jihua rencai wuzi biao" 蔣委員長十年計劃人才物資表 [Table of Chairman Jiang's ten-year plan of personnel and materials], *Kexue huabao* 12 no.1, 1945, 2-3.
[400] "Jiang weiyuanzhang," 2.
[401] "Jiang weiyuanzhang," 2.

basic principles of science. Chen specifically critiqued the government's focus on producing tools and machinery. "If the stable has good horses, but no one to ride them" he wrote, "then the horses are nothing but exquisite objects."[402] This metaphor equated new technologies with precious things that are nevertheless useless, until one learns the ins and outs of operating them. Chen's metaphor brings to mind a similar comparison made in a 1933 editorial titled "What is Scientization" by Cao Huiqun 曹惠群, a former editor of the journal. In this piece, Cao argued that scientization meant internalizing the scientific spirit, not purchasing foreign technologies that no one could use properly.[403] This time the technologies were not foreign, but in Chen's view, focusing on "things" was missing the mark.

Not much biographical information about Chen Yuesheng exists, but some important details can be pieced together from his published work. Chen was active in scientific writing from the 1920s into the early 1950s. In some of his earlier writing he identified as Chen Yuesheng of Heng Mountain (Heng shan Chen Yuesheng 衡山陳嶽生), meaning he was a native of Hunan province.[404] He wrote mostly about physics and astronomy, both in children's magazines and for educated audiences in publications such as *Eastern Miscellany* (Dongfang zazhi 東方雜誌), *New Science* (Xin kexue 新科學) and *Student's Journal* (Xuesheng zazhi 學生雜誌). During his tenure at *Kexue huabao*, Chen wrote articles on physics, the atomic bomb, and electricity. He also penned a science fiction novella titled "The Martian's Cannon" (Huoxing ren de dapao 火星人的大炮),

[402] Chen Yuesheng 陳嶽生, "Yuesheng gong ji hou jin shi" 嶽生恭錄後謹識 [Yuesheng's Post-script Comments], *Kexue huabao* 12 no.1, 1945, 3.
[403] Cao Huiqun 曹惠群, "Shenme jiao kexue hua" 什麼叫科學化 [What is Scientization], *Kexue huabao* 1 no.2, 1933, 1.
[404] Chen Yuesheng, "Mengnage guo de zuifan" 蒙拿哥國的罪犯 [The Xriminals of Mengnage], *Minzhong wenxue* 1 no.8, 1923, 1-4.

and editorials about the movement to popularize science. Alongside his own writing, Chen translated articles and books from French and English, indicating that he may have studied abroad.

Chen's approach to science popularization echoed the values on which *Kexue huabao* was founded, namely the importance of visuals both to explain scientific principles and to captivate an audience. Much of his work was geared towards young readers and elementary school children. In 1934, he wrote an article series titled "Physics Chats" (Wuli mantan 物理漫談) for the magazine *Children's World* (Ertong shijie 兒童世界). The series was based on an English translation of a book originally in German. In the introduction to the series, Chen explained that he chose to translate this work not only because the writing was clear and interesting, but also because the accompanying images were pleasant and eye catching. Visuals, he wrote, were an important component in provoking young readers' curiosity towards physics.[405] Chen believed that creating a sense of wonder and invoking the reader's interest in science were critical to disseminating scientific knowledge, and this could be done not only through accessible texts but more importantly through visually appealing images. His writing placed children and youth as the main audience for science popularization.

The government's focus on training in applied science was contested from another angle. Chen Yuesheng represented the view that scientizing China was best achieved by spreading basic knowledge to a broad audience. But others held the opposite approach, arguing that resources should be directed at deepening the knowledge of fewer experts. This point was conveyed in the lead editorial of the October 1945 issue, titled "Ultimate Victory is in Drawing Lessons from Science Education" (Zuihou shengli zai jinhou kexue jiaoyu shang de jiaoxun 最後勝利在今後

[405] Chen Yuesheng, "Wuli mantan" 物理漫談 [Physics Chats], *Ertong shijie* 32 no.12, 1934, 24.

科學教育上的教訓). The editorial was written by Yang Jifan 楊季璠 from the Academia Sinica Institute of Physics. Yang presented the two dichotomous concepts introduced in the beginning of this chapter: applied and theoretical knowledge (*yingyong lilun* 應用理論); and popular and thorough (*puji shenru* 普及深入).[406] Yang claimed that the first dyad – applied versus theoretical knowledge – was a false dichotomy. He argued that theory and practical knowledge were mutually constructive: any kind of applied science was derived from pure research and theoretical principles, such as the laws of energy or combinations of materials. Atomic energy and the atomic bomb, the pinnacle of the utility of science, he wrote, would not have been possible without decades of research on theoretical questions in physics.[407] His argument echoed the debate within the scientific community and between scientists and the state, in which the former argued that theoretical research was as important as applied science.

The second set of concepts, popular and thorough, posed a contradiction that Yang believed could not be surmounted. He argued that disseminating scientific knowledge compromised its accuracy. When writing for an audience with no background in science, technical terminology is replaced by everyday language and metaphors. These inevitably lead readers astray, whether through misunderstanding or because they take the metaphors at face value. In depth, thorough, knowledge of a specific discipline could not be widely accessible because it required years of training. Popularization was not completely useless in Yang's view: the goal of science popularization was that the general population would not be completely mystified by technologies of the modern, "civilized" world. But experts with deep knowledge deserved more resources, since they would lead China to be a scientific nation on a par with other world powers. Yang observed

[406] Yang Jifan, "Zuihou shengli zai jinhou kexue jiaoyu shang de jiaoxun" 最後勝利在今後科學教育上的教訓 [Ultimate Victory is in Implementing the Lessons of Science Education], *Kexue huabao* 1945 vol. 12 no.1, 4-5.
[407] Yang, "Zuihou shengli," 4.

that the current state of science education favored “applied and widespread” knowledge (*yingyong puji* 應用普及).[408] However, this was at the expense of providing deep and thorough education, with a focus on theory. Yang made the case that the kind of science education needed to achieve “ultimate victory” was deeper knowledge for fewer people, questioning the extent to which science can, or should, be shared by all.[409]

For readers of the magazine, the question of utility had different meanings. One reader, the father of a second-year university student, wrote to the journal’s “Readers’ Letters” column with a dilemma that was causing significant strife in his family. The son had originally wanted to study civil engineering, but the father persuaded him to take electric engineering instead. The son, now in his second year, regretted the decision, and accused his father of ruining his future employment prospects. The father wrote to ask the editors what kinds of jobs were available to electric engineers, and should the son switch to civil engineering instead?[410] Many of the journal’s readers were middle and high-school students, who pursued science education as a path to employment. Applied fields such as mechanics, electric, and civil engineering were therefore not just connected to national rebuilding but were personal career opportunities. The needs of the readers were an additional consideration to the editors when deciding on the form and content of the journal in the post-war world.

Yang Jifan’s editorial brought to the fore a question that impacted the fundamental mission of the journal. To what extent can science be accessible to people with varying degrees of education, while also being accurate? The position expressed by Yang in 1945 pitted popularizing

[408] Yang, “Zuihou shengli,” 5.
[409] Yang, “Zuihou shengli,” 5.
[410] “Yinggai du shenme xi” 應該讀什麼系 [What Major to Study?], *Kexue huabao* 13 no.1, 1947, x-8.

science against in-depth knowledge. While Yang Jifan did not see a contradiction between applied and theoretical knowledge, he did believe in a firm line separating what he called accurate scientific knowledge and the knowledge available to non-professionals. Yang's view may have been contradictory to the spirit of the journal that was expressed in the 1933 opening statement, that those most in need of scientific knowledge were the "ordinary people", and particularly children, farmers, and workers.[411] In the late 1940s, China still had a mass population of illiterate citizens, but also more schools and a growing number of secondary students. Would the journal be financially viable if it tried to reach rural readers? Or should the editors focus on catering to the tastes of urban males with a high-school education, who worked in jobs that required literacy and provided some expendable income?

<u>A Community of Science Enthusiasts</u>

Readers' Survey

In February 1947, *Kexue huabao*'s editors published a survey. It was framed as part of the journal's efforts to contribute to the reconstruction of China by "renewing" their publication. Assessing the needs and opinions of the readers, the editors explained, would allow the journal to keep improving.[412] The survey was published as a questionnaire to be filled in and mailed to the editorial office. It contained questions on the accessibility of articles, the topics readers were interested in, the images and visuals in the journal, as well as questions aimed at understanding consumption patterns. The questions enabled the publisher to get a sense of the readers' position in the grey area between professional scientist and people with no prior familiarity with science.

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[411] Wang Jiliang, "Fakan ci" 發刊詞 [Opening Remarks], *Kexue huabao* 1 no.1, 1933, 1. See also Lu Yudao, "Zhongguo zhi kexue hua yundong" 中國之科學化運動 [China's Scientization Movement], *Kexue huabao* 3 no.24, 1936, 1.

[412] "Kexue huabao zhengqiu quanguo duzhe yijian" 科學畫報征求全國讀者意見 [*Kexue huabao* Solicits Readers' Opinions], *Kexue huabao* 13 no.2, 1947, x-2.

The questionnaire asked readers to indicate, in percentages, how much of the journal they found too difficult to understand (*tai shen* 太深, *you % kanbudong* 有%看不懂), and how much was too easy and not interesting (*tai qian* 太淺, *you % meiyou yiyi* 有%沒有意義). Another question asked readers to choose the kinds of articles they were most interested in from a list, which included topics such as "general social commentary", "home laboratory", "new chemistry," "new weapons," "new developments in aviation," and "stories about scientists," among others. Another question relating to content asked if readers would be interested in articles "introducing the history and present state of research institutes and universities in China and abroad."[413] This question would provide information about how many of the readers were interested in higher education and specialized scientific training. A blank space was provided for readers to indicate their education level.

Other questions aimed to solicit demographic information more directly. They asked readers to describe how they got the journal – did they subscribe to it, buy it occasionally, or get it as a loan from a library or friend? What did subscribers do with the journal after reading it – did they collect the issues, lend them out to friends or family, or discard them? How many people did they know who also read the journal? The questionnaire asked readers who were not subscribers where they purchased the journal, and how much they paid for it. These questions gave the editors an idea of the journal's reach beyond the number of subscribers, information about the readers' economic conditions, and insight into the circulation network.

Another set of questions asked readers to comment on the images and style of the journal. What did readers think about the layout of the texts and images in the journal? Options included

[413] "duzhe yijian", *Kexue huabao* 13 no.2, 1947, x-2.

general comments such as "good", "not visually appealing", "too flowery", "too boring", and more specific comments such as "titles are not eye-catching enough", "border design and patterns should occasionally change". Readers were asked to comment on the quality of images, size of texts, the covers and color schemes, and the paper quality. These questions signaled that the journal wished to align its visual language with the expectations of readers. Were readers put off by ornate borders and designs, or did this make the articles appear more approachable?

The paper and image quality were indeed topics of concern to readers, who expected good quality images for the price they were paying. In the first issue of 1947, published in January, three letters from readers commented about the material aspects of the journal. Zhang Weizu 章慰祖 from Hangzhou identified himself as a long time reader, and lamented that in recent years images had declined in quality. Some images were not sharp enough, making the articles that they accompanied harder to understand.[414] Zhang's concern was not with the aesthetic appeal but with the educational objective of the images. The ability of visuals to serve an explanatory purpose depended on their quality. Other letters printed in the same issue asked for longer articles and better paper quality.[415]

The readers' survey was published in the journal's February and March issues of 1947. In March, the editors published an initial overview of the questionnaire, after receiving 420 letters within one month. According to the editors, the results of the survey showed that 50 percent of respondents found the content to be "just right" (*zheng hao* 正好), 45 percent wrote that a quarter

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[414] Zhang Weizu 章慰祖, "Tupian bugou qingxi" 圖片不夠清晰 [Images are not Clear Enough], *Kexue huabao* 13 no. 1, 1947, x-7.

[415] "Jiaqiang Kexue huabao de faxing wang" 加強科學畫報的發行網 [Strengthen *Kexue hubao*'s Circulation Network]; "Pianfu hai xian bugou" 篇幅還嫌不夠 [Article Length is still Insufficient], *Kexue huabao* 13 no.1, 1947, x-4 – x-8.

of the content was too easy or unnecessary, and 5 percent answered that over half of the articles were too hard to understand. According to these results, only a small minority of readers found the journal's articles inaccessible, meaning that most readers had previous science education. The editors claimed that half of the readership found the journal to be suited to their level and interest, and slightly less than half indicated they could handle content which was more specialized and in-depth.[416]

In April, the editors published a conclusion of the results, after receiving almost 2700 responses from readers. Even if the magazine received half that number of responses, it would still represent slightly over ten percent of the total circulation number of 10,000 copies per issue. In the conclusion they stated that the breakdown of responses to the question about the level of the journal remained the same. After going through all the results, almost half the respondents answered the content was "just right", and 40 percent thought it was too easy.[417] Given that the editors did not publish a detailed report of the results, only a narrative summary, it is hard to assess to what degree the results may have been curated. The results may have been tweaked by the editors to provide a justification to aim the publication at a more educated audience.

Letters from readers that were published in subsequent issues seemed to be in accordance with the survey's results. One letter was from a reader who asked for the journal to provide the original language for translated terms, including names of foreign scientists, places, and scientific terminologies, to prevent confusion and enable readers to find the correct material.[418] Two readers who identified as students wrote a letter together asking for a column introducing new scientific

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[416] "Bianji shi" 編輯室 [Editorial Note], *Kexue huabao* 13 no.3, 1947, 134-135.
[417] "Bianji shi" 編輯室 [Editorial Note], *Kexue huabao* 13 no.4, 1947, 243.
[418] Chen Yichen 陳佚塵, "Yi ming jia fu yuanwen" 譯名加附原文 [Add Original to Translated Terms], *Kexue huabao* 13 no.3, 1947, 131.

theories from abroad. The two wrote that even though the magazine was directed at a general audience, there were also many readers with a higher level of knowledge that should be accommodated.[419] The title of this letter, chosen by the editors, was "Requesting more Advanced Content." The editor responded that most readers of *Kexue huabao* were ordinary people without specialized knowledge. Introducing new theoretical concepts in a way that was accessible to them was too difficult. The editor recommended that those seeking more advanced knowledge should read *Science* magazine, also published by the China Science Society.[420] The letters may have been sent in response to the survey – indeed, some readers mentioned the survey in their letters. However, they cannot be taken at face value. The choice of which letters to print and what titles to give them should be read as a statement of the editor's and publisher's agenda, and not a neutral representation of the readership. In this case, publishing letters of readers with a higher level of education, such as students and people who could read foreign languages, gave the editors a justification for printing more advanced content. Similarly, the survey results that showed that half the readership thought the journal's content was too simple may have been curated by the editors to permit them to aim the publication at a more educated audience.

Another indication that readers were not complete novices was the topics they requested. The most requested topics for articles were nuclear energy, chemistry, physics, new military technology, and factory management (*gongcheng neibu poushi* 工廠內部剖視). These were the fields in which new developments were highly publicized because of wars in previous decades, and audiences in England and the United States were similarly interested in these topics.[421] The

[419] Xiao Shunda 蕭順達 and Yu Zhizhou 余知週, "Neirong zai yao gaoshen yi xie" 內容再要高深一些 [Requesting More Advanced Content], *Kexue huabao* 13 no.3, 1947, 133-134.
[420] Xiao and Yu, "Neirong," 134.
[421] For the United States, see Marcel C. Lafollette, *Making Science our Own: Public Images of Science 1910-1955*, (Chicago: The University of Chicago Press, 1990), 165-168; In the British context, Bowler identifies Atomic Physics and Relativity amongst several topics which were widely discussed in popular science publications. Peter

second most requested topics were supplementary teaching material for science majors (*like cailiao* 理科材料), wireless technology, medicine, and "home laboratory" (*jiating shiyanshi* 家庭實驗室).[422] This suggests that the magazine was read by high-school and university students who had access to lab equipment and books. Some of the most highly requested topics correspond to fields that were considered "useful" or "applied" science. Factory management and wireless technology are two self-explanatory examples. The least requested topics were plant and animal biology and general introductions to different disciplines. The responses suggest a readership of high-school and university students and graduates, workers in manufacturing and chemical industries, and teachers.

Summarizing the results of the survey, the editor wrote that the guiding principle in selecting articles for publication was not to equally represent all scientific fields, or to equally include local and foreign science. The two main parameters that the editors considered when choosing articles reflect two groups of audience for the publication. Reading materials that "ignite[d] the readers' scientific thinking" (*faqi duzhe de kexue sixiang* 啟發讀者的科學思想) were directed at younger students, children, or readers with no previous formal education.[423] These readers were imagined to be ignorant of science and its importance to their daily lives. Articles on animal and plant biology were the least requested in the survey, but the editor declared they would continue publishing these kinds of articles. The editors believed these articles were the most conducive to eliciting interest in science because they were most directly relevant to human life.[424] Plant and animal biology had been the main topics in science articles for women and children in

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Bowler, *Science for All: The Popularization of Science in Early Twentieth Century Britain* (Chicago: The University of Chicago Press, 2009), 34-42.

[422] "Bianji shi," 243.

[423] "Bianji shi," 241.

[424] "Bianji shi," 241.

Kexue huabao's past issues and in other publications. Biology was seen as a convenient entry point into science because, presumably, children and women were familiar with animals such as cats, cows, or different kinds of birds, and would therefore find scientific writing on animals – or plants – familiar enough to not be intimidating.

The second criteria for selecting content for the journal was its usefulness as reference material and for further study (*shiyong cangong* 實用參攻).[425] These kinds of articles, which may have included columns such as "home laboratory," as well as articles on physics, chemistry, and principles of mechanics were aimed at student taking science classes from middle school through early university education. It could also be used by teachers to supplement textbooks. These articles were also probably interesting to readers who were not students, but science enthusiasts working in various professional and mechanical industries.

The results of the survey and the editor's response reveal a conflict between the editorial intention and actual readership. The magazine's founding ethos – which was reiterated in the discussion of the readers' survey – spoke of the publisher's desire that the magazine carry out an enlightenment function, by drawing in a potential reader who was skeptical about science's place in their life. But by 1947, it seemed that the magazine's main audience were not complete novices but educated people who wanted to increase their knowledge in specific scientific fields outside of institutional venues. This group, not surprisingly, were also the most active participants in the publication. The financial imperative for the publisher supported catering to the reader's tastes. According to the survey, that meant more articles on contemporary scientific topics that required readers have some background in the discipline.

[425] "Bianji shi," 241.

On the one hand, the editor's response to the survey continued to uphold the ideal of appealing to uninitiated readers. On the other hand, publishing the results of the survey (which may have been "doctored", especially given the neat statistical breakdown) and selecting letters that demonstrated the readers themselves wanted more advanced articles was a way for the journal to justify the gradual shift in content without abandoning their founding mission. For the sake of this potential reader and the idea of arousing an interest in science, the editors reserved a place for columns and articles that assumed less previous knowledge. However, between 1947 and 1952, with a small detour in 1950, the content of the journal shifted to cater to the interests of readers who were not novices but saw themselves as participants in making science.

Reader's Club

By the late 1940s, *Kexue huabao* had a community of readers who were not passive recipients of knowledge. These readers actively participated in doing science in various forms, including through the journal. One of the ways was a reader's club (*duzhe lianyi hui* 讀者聯誼會) established in 1947. The idea for the club came from the readers themselves, indicating that they saw themselves as part of a community of like-minded people. This community was based on affective connections to science, a view of fellow readers as potential friends, and on ways of practicing science outside institutional frameworks. Those who wished to participate in the club were not scientists by vocation, but they nevertheless engaged in making scientific knowledge, and identified as science enthusiasts. Many of them were students who used school facilities to conduct experiments and read science books in their free time. The readers who sent in short biographies wanted to make connections that would help them in their different scientific endeavors. These personal ads provide an important avenue through which to assess who were the most engaged and active readers of *Kexue huabao*.

The reader's club was initially suggested by a reader named Liu Ziqiang 劉自強 (b. 1927) whose hometown was Changzhou city in Jiangsu province. Liu, age 20, was residing in Beijing where he had graduated from high-school and was preparing to take university entrance exams. A soon-to-be university student, Liu identified himself as a science researcher (*yanjiu kexue de ren* 研究科學的人), despite the fact he was not part of an institution or did science professionally.[426] In his letter to the editor, he wrote that "those who do scientific research cannot succeed if they are secluded," and that sharing knowledge and exchanging ideas was essential in any scientific field.[427] He asked the magazine to organize a readers' club to exchange research results, as well as to make friends. Liu's main reason for wanting to connect with other readers was to gain knowledge and further his research while forging connections with others who shared his interests.

Another reader, Chen Dingxin 陳鼎新 from Hepu village in Chaoyang prefecture, Guangdong province, highlighted the camaraderie aspect of a potential readers' club. The magazine's readers, according to Chen, were all "science enthusiasts" (*zuixin kexue* 醉心科學).[428] A club would enable them to come together and encourage each-others' scientific spirit. Like Liu Ziqiang, Chen also held the view that communication was essential to scientific research, but his letter emphasized the positive affective elements of the club, such as companionship and "enthusiastically uniting our scientific spirit".[429] He suggested that to join the club, readers would send in a short biography that included their age, location, gender, educational background, and marital status, as well as the fields of science they are interested in. This information would allow

[426] Liu Ziqiang 劉自強, "Zuzhi duzhe lianyihui" 組織讀者聯誼會 [Organizing a Reader's Club], *Kexue huabao* 13 no. 3, 1947, 134.
[427] Liu, "Zuzhi duzhe," 134.
[428] Chen Dingxin, "Zuzhi duzhe lianyihui" 組織讀者聯誼會 [Organizing a Reader's Club], *Kexue huabao* 13 no. 6, 1947, 354 – 355.
[429] Chen Dingxin, "Zuzhi duzhe."

fellow readers to identify who shared not only their scholarly interests, but also who had a similar background and would be compatible as a friend. Chen also suggested each person attach a picture of themselves so members could get to know their new friends' faces. Chen proposed that after receiving the letters, the journal's editors would organize them into smaller groups according to interest. Each group would have a leader who would coordinate group activities and discussions and report them back to the journal. This way, all readers could benefit from the club.[430]

The editors announced that they would organize a club, but on a smaller scale than that suggested by Chen Dingxin. To join the club, interested readers sent a short letter with biographical information, fields of interest, and their special expertise. Readers were also asked to indicate what kind of relationship they are seeking – sharing research results, reading together, researching together, or sharing materials. The editors saw the club as a way for readers to "make friends with kindred spirits" (*jiaojie zhitong daohe de pengyou* 交結志同道合的朋友).[431] The editors published the letters, which resembled personal ads, in the following issues. Readers interested in responding sent their initial letter to the magazine's office, and the editors would then forward it to its addressee.

Submissions to the Reader's Club offer the richest biographical information about readers. They included details that were normally excluded from readers' letters to the editor, such as age, occupation, and educational background. Using these details in a horizontal and integrated approach allows us to trace and identify some of the readers, either in other columns of *Kexue*

[430] Chen, "Zuiji duzhe lianyihui".
[431] "Bianji shi" 編輯室 [Editor's Note], *Kexue huabao* 13 no. 6, 1947, 400.

huabao, or in other contemporaneous journals.[432] The information presented in the ads themselves also allows us to make some observations about the magazine's audience.

A total of 89 personal ads of readers hoping to find like-minded friends were published. Although these only represent a small fraction of the journal's readership, it gives some insight into important demographic information about this group. Naturally, those who sent in letters to participate in the club were the most engaged and active readers, therefore skewing towards a much more educated group with more daily interactions with science. All 89 letters were sent by men. Although the journal tried to appeal to women and girls, the percentage of female readers remained small. Male audiences took center stage in the parts of the journal that allowed active participation from readers. The average age of readers who sent in personal ads was 20. The youngest club participant was 12, and the oldest 46.

Those who wanted to join the club were mostly well educated. From the 82 personal ads that included the sender's educational background, three-quarters (60) had a middle school education or above. Out of 89 total participants, a third were high-school students (29 participants), 11 had graduated middle school, and 11 graduated or were in vocational and professional schools. Seven participants had only primary school education, and a similar number – seven – had not disclosed their educational background (Table 1). Not all student participants studied science. One participant, Liu Qubing 劉去病, a 25-year-old from Tianjin, was a third-year undergraduate in History at the prestigious Nankai University. He planned to open an electrical machinery company after his graduation and listed wireless radio and meteorology as his main interests.[433]

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[432] On horizontal, situated, and other methods of analyzing commercial periodicals see Joan Judge, *Republican Lens: Gender, Visuality, and Experience in the Early Chinese Periodical Press* (Oakland: University of California Press, 2015), 39-48.
[433] "Duzhe lianyi hui" 讀者聯誼會 [Reader's Club], *Kexue huabao* 13 no.8, 1947, 543.

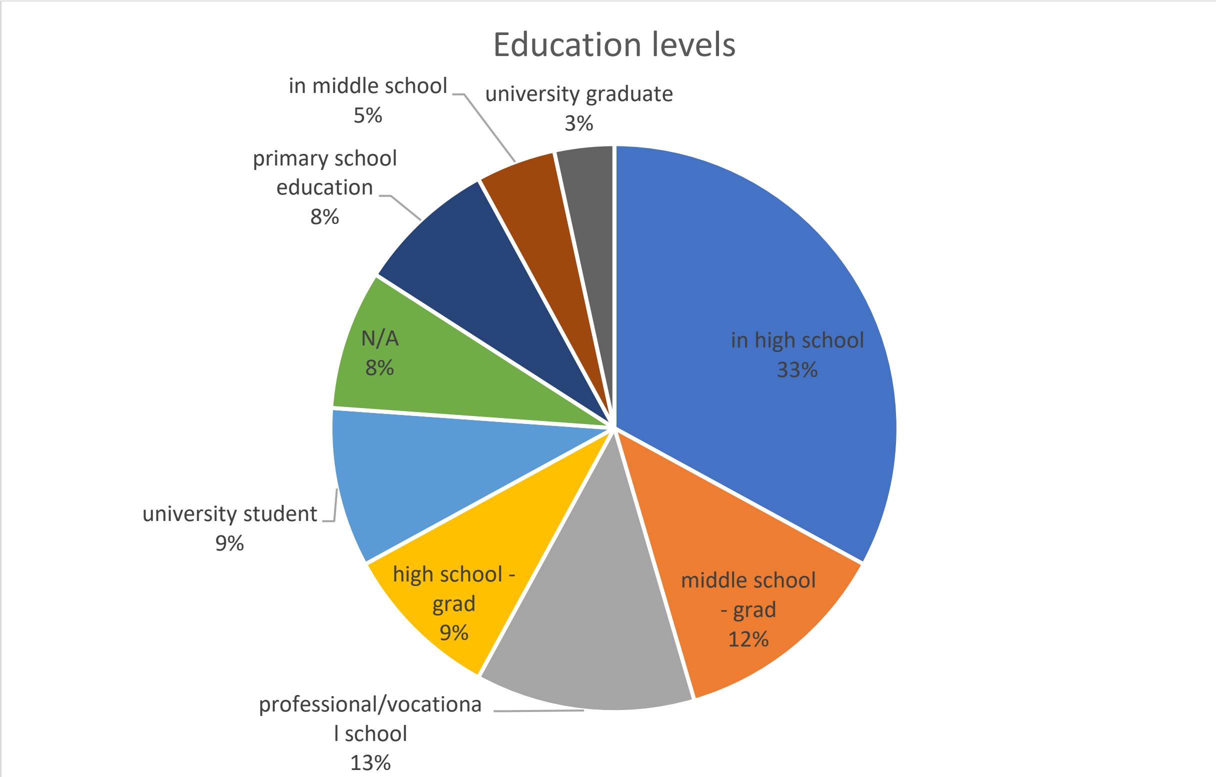

Table 1: Readers' educational background

In terms of geography, the readers who joined the club represented a much smaller geographic spread than the journal's actual circulation. Most of the letters – 27 out of 89, or thirty percent, came from Shanghai. Another quarter were from cities and towns in Jiangsu province. Most of the participants (55 out of 89) resided in big cities and provincial capitals, such as Suzhou, Nanjing, Beiping (the Republican-era name of Beijing), and Qingdao. Only six participants were in provinces further removed from the affluent coastal region, but even these readers resided in cities such as Kaifeng, Hankou, and Shenyang.

The participants in the club were not professional scientists but had vocations that involved scientific and technical knowledge. Half of the personal ads came from current students, ranging from primary school to university undergraduates. Most of these students were in high-school and therefore had access to textbooks and potentially to laboratories with equipment and materials which they could use for experiments. Many of the readers who were in high-school or middle school expressed that they wanted to become scientists, engineers, or inventors. Ten participants worked in industrial labor jobs, including agriculture industry workers in rice and flour mills, and chemical industry workers. Eleven had white-collar jobs in banks, insurance, or as teachers. Five readers were members of the military and police (Table 2).

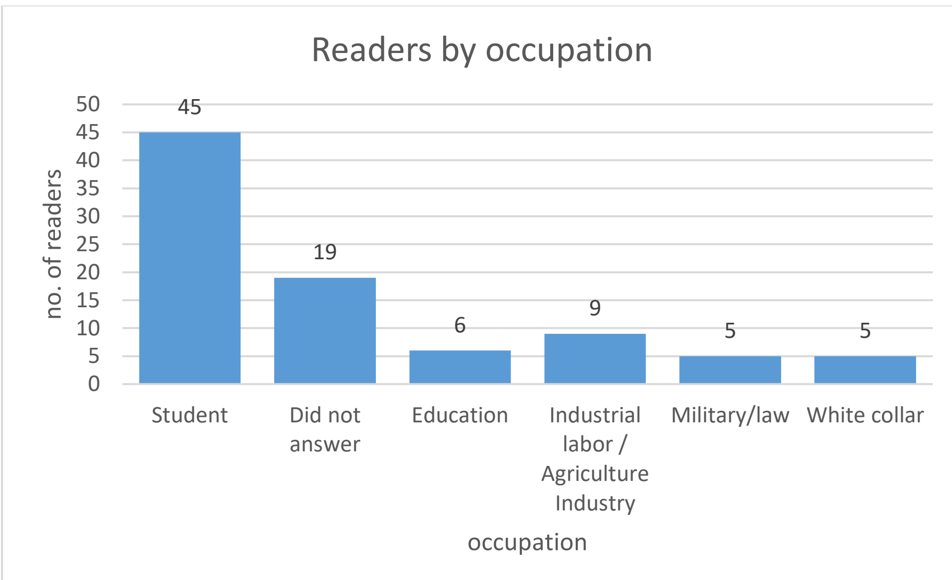

Table 2: Readers' occupation

Yang Anding 楊安定, a reader from Hong Kong, was studying foreign languages at Guangzhou University and working as a teacher. He was interested in chemistry and had a small home laboratory.[434] In addition to reading *Kexue huabao*, Yang had read and written to different journals for students, which allows us to gain some insight into his education history and career path. In 1941, at the age of sixteen, Yang graduated from Huaqiao middle school (Huaqiao zhongxue 華僑中學) in Hong Kong. A letter he sent to the editor of *Xuesheng zazhi* (Student

[434] "Duzhe lianyi hui," *Kexue huabao* 13 no.8, 1947, 543.

Magazine 學生雜誌) reveals that to Yang, science education represented both a personal opportunity and a national imperative. After eight years of education, he had the option of either attending a vocational school or continuing to high school. In the letter, he requested information about the best vocational schools and their tuition.[435] He asked the editor whether China needed more students with applied technological education, or a broader high-school education. Yang was clearly weighing his options for the future under the uncertainties of wartime. Would he be better off learning a specialized technical skill, or gaining a higher degree of education? The debate over the usefulness of applied science education as opposed to theoretical research found resonance in the personal decisions that educated, middle to upper class Chinese citizens faced.

In 1947, when Yang sent his submission to the Reader's Club, he was a university student in the foreign language department. He was proficient in English and had advanced knowledge of chemistry, which he probably acquired in high school rather than a technical school. Yang published two annotated English translations of Chinese news reports. One of his annotated translations was published in *Xin xuesheng*'s "Language Learning" section, as well as in *Xiandai Yingyu zazhi* (Modern English Magazine, 現代英語雜誌), a bilingual English-Chinese magazine for language learning.[436] He also maintained an interest in chemistry. In 1944, when he was 19 years old (and probably newly graduated from high school), he published an article titled "Methods of Balancing Chemical Equations" in *Xin xuesheng*.[437] Many high school students, Yang wrote, get a headache at the mere mention of chemical equations. But if they learned the principles of

[435] Yang's letter was not published in its entirety but was summarized by the editor. "Guanyu xianxing de jiaoyu zhidu" 關於現行的教育制度 [About the Current Education System], *Xuesheng zazhi* 21 no.6, 1941, 74.
[436] Yang Anding 楊安定, "Jap (sic) War Prisoners in Peace Village" Heping cun de riben fulu 和平村的日本俘虜, *Xin xuesheng* 11, 1944, 105-107.
[437] Yang Anding 楊安定, "Huaxue fangchengshi de pingheng fa" 化學方程式的平衡法 [Methods of Balancing Chemical Equations], *Xin xuesheng* 11, 1944, 25 – 28. The article was reprinted in the same journal in 1947.

equations and a few methods of balancing them, they would not need to rely on memorizing to write out balanced equations.[438] Yang then explained and provided examples of four techniques for correctly writing a chemical response. Despite his knowledge in the theory and principles of Chemistry, his submission to the Reader's Club suggests that it remained a hobby, rather than a profession.

Regardless of their education level or profession, almost all the readers who wanted to take part in the club wanted to *do* science, through experiment, model building, and research. A few readers, like Yang Anding, mentioned having a "small home laboratory," and one had a small library and wanted to exchange books with other club members.[439] Hu Wenlong 胡文龍, a policeman from Shanghai and high school graduate, wanted to build his own home laboratory to do experiments on colloids.[440] Several participants expressed their desire for the club to build a laboratory. Zhou Renkui 周仁奎 was a standout in terms of occupation and educational background. He was 23 years old, had a primary school education, and worked at the Dafeng Weaving Mill in the outskirts of Shanghai. His special skill was fixing weaving machines. He wanted the club to organize trips to watch experiments.[441] A third-year student at Yanjing University in Beijing wanted to exchange equipment and materials with other club members, and suggested forming a buyers co-op to get reduced rates on scientific equipment.[442]

Club participants had different ways of practicing science. Several wrote that their special skills included fixing electronics, constructing wireless radio sets, and model-making. Readers

[438] Yang, "Huaxue fangchengshi," 25.
[439] "Duzhe lianyi hui" 讀者聯誼會 [Reader's Club], *Kexue huabao* 13 no.9, 1947, 558.
[440] "Duzhe lianyi hui" 讀者聯誼會 [Reader's Club], *Kexue huabao* 13 no.10, 1947, 664.
[441] "Duzhe lianyi hui," 664.
[442] "Duzhe lianyi hui," 664.

who worked with mechanical equipment used their experience to make things on their own. A mechanic at a textile factory in Zhongshan city in Guangdong province, Cai Zhenhai 蔡振海, wrote that he had been working on developing industrial machinery in his spare time, and he hoped to construct an affordable fuel engine (*jian jia ranlioa fadongji* 廉價燃料發動機).[443] Another reader working at a flourmill wrote that he liked to draw designs. By making drawings, constructing models, and reading, the readers engaged in the practice of science without access to spaces such as schools or laboratories. These modes of making and tinkering are part of a longer history of such practices dating to the 1910s. Eugenia Lean argues that small scale manufacturing, tinkering, and improving upon existing inventions, were new ways for Chinese men-of-letters to engage with scientific knowledge outside professional spaces.[444] But by sending in their submissions to the Readers' Club, and through reading the journal, *Kexue huabao*'s readers obtained a form of validation that their hobbies of experimenting, researching, and making things, fell under the purview of science.

One of the readers who joined the club, Bian Depei 卞德培 (1926-2001), became a prolific popular science writer, who wrote and edited several dozen books on astronomy for lay audiences and particularly for children. Bian was born in Zhejiang's Pinghu town. When the Second Sino-Japanese war erupted in 1937, he was sent to his paternal grandparents in Shanghai, together with his sibling.[445] The family's financial situation worsened as the war progressed, and his grandparents had to sell their house. Bian still attended school, where he encountered some books

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443 "Duzhe lianyi hui," 558.
444 Eugenia Lean, *Vernacular Industrialism*, 8.
445 Wu Shuiqing 吳水清, "Fengxianzhe shi meili de – zhuiyi zhuming kepu zuojia Bian Depei xiansheng" 奉獻者是美麗的 – 追憶著名科普作家卞德培先生 [The Devotee is Beautiful – Remembering Celebrated Popular Science Writer Mr. Bian Depei], *Kexue xinwen* 科學新聞, 2001 no.33, 20.

that sparked his interest in astronomy. He could not afford to buy his own books, but he copied and took notes on textbooks he found in the library.[446]

In 1945, Bian graduated from the Sino-French high-school (Zhong-Fa gaozhong 中法高中) in Shanghai and prepared for his future. He wanted to attend university, but the financial circumstances of his family required he find employment. Bian found a job as an intern at a French owned bank in Shanghai. By the time he wrote to join the Readers' Club of *Kexue huabao* in 1947, he was able to spend some money on developing his knowledge of astronomy: he could afford to buy books and had an 80mm refracting telescope.[447]

Although he did not have any professional training and did not attend university, Bian forged a path for himself as a science popularizer specializing in astronomy. He started writing articles on astronomy while still employed at the bank, and in 1947 he wrote a science fiction novel.[448] In 1948, he met Li Yuan 李元 (1925 – 2016), an administrator at the Nanjing Purple Mountain Observatory (Nanjing zijinshan tiantai 南京紫金山天文台). Both men shared a love of astronomy and had a similar educational background. They collaborated on editing an astronomy supplement for the magazine *Mass Science* (Kexue dazhong 科学大众, published 1946-1950), and on other edited collections.[449] In the following years, Bian took part in different science

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[446] Bian Depei 卞德培 , "Langhua yu xiaobing" 浪花與小兵 [Life's Little Episodes] in Bian Depei, *Di shi da xingxing zhi mi* 第十大行星之谜 [The Riddle of the Tenth Planet] (Liaoning: Liaoning Shaonian ertong chubanshe, 2010), 1-4. Originally published in *Zhongguo shao'er kepu zuojia zhuanlue* 中國少兒科普作家傳略 [Brief Biographies of China's Authors of Popular Science for Children], 1988.
[447] Bian Depei, "Langhua," 3.
[448] In his letter to *Kexue huabao* Bian wrote that he had written a science fiction novel "Diqiu de zhimindi" 地球的殖民地 [Earth's Colony]. He also mentioned writing a novel in the biographic essay he wrote, but did not provide its title or publisher. The novel may have not been published, or published with a small press that had disappeared after 1949. "Duzhe lianyi hui" 讀者聯誼會 [Reader's Club], *Kexue huabao* 13 no. 8, 1947; Bian, "Langhua," 2.
[449] Chen Zujia 陈祖甲 Huang Wei 黄威, "Kepu shuangxing qingman Zhonghua – ji huodeguoji xiao xingxing mingming de kepu zuojia Li Yuan Bian Depei" 科普双星情满中华——记获得国际小行星命名的科普作家李

popularization projects: he was a science advisor at the Shanghai Science Education Film Studio and co-hosted a three-hour long broadcast on the Shanghai People's Radio during a full lunar eclipse in June of 1953. He also joined the China Astronomy Society. In 1954 he moved to Beijing to participate in the preparatory committee for the Beijing Planetarium, where he was employed until his retirement in 1988. [450]

Bian's example is illustrative of the role that popular science publications such as *Kexue huabao* had both in exposing educated, urban men to scientific knowledge and in providing them opportunities to pursue scientific knowledge. In his recollections, Bian credited popular science books with his attraction to astronomy: "the warm and lively style [of these books] described to me the beautiful and previously unknown subject of astronomy... the charms of nature (*da ziran* 大自然) captivated the heart of this middle schooler."[451] Although he did not specify having read *Kexue huabao* as a child, he was a reader of the journal as a young adult forging a career. The magazine shared the intent to instill in readers a sense of wonder and joy of discovery with the books that Bian had directly referenced, but ultimately succeeded more in appealing to an audience with an existing infatuation with science. Bian's narration of his own "awakening" to science contained similar ideas of wanting to enchant young readers with the wonders of nature. Bian's writing about his encounter with natural knowledge as a child echoes the kinds of sentiment we find in other readers' letters, namely their sense of wonder and interest in science. His path to becoming a science popularizer was unique, but it nevertheless suggests the ways educated men could find careers in science outside academic circles.

元、卞德培 [The Two Stars of Popular Science, Beloved by the Nation – Marking the Naming of Two Meteors after Popular Science Writers Li Yuan and Bian Depei] *Keji chao* 科技潮, 1998 no. 6, 15-16.
[450] Bian Depei, *Di shi da xingxing*, 550-551.
[451] Bian, "Langhua", 3.

Readers' Letters

The group of readers who practiced science started receiving more acknowledgment in the journal. Their knowledge and expertise were being increasingly recognized by the editors, and were given more physical space on the pages of *Kexue huabao*. The "Readers' Letters" column (Duzhe lai xin 讀者來信, changed to "Reader's Letter-box" Duzhe xinxiang 讀者信箱 in 1948) had always been a space for readers to actively participate in the journal. However, before the war the column featured questions from readers that the editors would forward to experts in different fields. This format positioned the journal and its writers as educators imparting knowledge to readers. The column was discontinued in 1939, due to breakdown of postal communications. It returned in 1947 but its tone changed, giving the letters received from readers a more authoritative position. In this way, the column served to undermine an assumed dichotomy between professional scientists and novices. Readers doing science outside of the professional, institutional realm found a space to share their questions and ideas, comment on articles, and participate in discussions on science.

In the first issue that saw the return of the column, a note to the readers outlined the kinds of correspondence the editors were seeking. The note asked readers to send in their "discussion of articles published in the magazine" (*dui wenzi yousuo taolun* 對文字有所討論), "opinions on scientific matters" (*xueshu fangmian you yijian* 學術方面有意見), and suggestions for the editors.[452] The column, which previously had served as a platform for readers to seek expert advice from the magazine, was now a space for readers to assert their own scientific knowledge and expertise. By soliciting readers' discussion and opinions on scientific matters, the editors

[452] "Duzhe laixin" 讀者來信[Readers' Letters], *Kexue huabao* 13 no.1, 1947, x-3.

recognized that their readers had knowledge worth sharing with the broader community of readers. The notice was concluded by stating that the content of all letters published is the sole responsibility of the author. This disclaimer absolved the editors from having to back up any potential controversial claims, but was also a recognition of the readers' ability to stand behind their own ideas. The readers of *Kexue huabao* were no longer primarily viewed as recipients of scientific knowledge from the magazine's experts, but participants in a conversation about science.

Readers were more than ready to occupy the new position of authority the journal offered them, and supplied the editors with their opinions, questions, and ideas. The official announcement of the column's return and the call soliciting letters were published in January 1947, but the community of readers was already increasing their involvement and ownership of the journal. Readers had been sending in letters before the column officially returned to print, some asking when the column would return, some raising concerns over the availability of magazines and potential price increases, and some sharing their opinions on science and society. The January 1947 issue printed the kinds of letters editors were encouraging readers to send, signaling that the magazine was taking cues from readers.

Between 1947 and the end of 1950, in volumes 13 through 16, the Reader's Letters column positioned readers in a space between expert and knowledge-seeking novice. Although the readers were not professional scientists, many of them worked in fields and jobs that required technical knowledge and familiarity with basic or advanced scientific concepts. Others gained this knowledge through school and reading. The column provided a space for readers to present their ideas, raise questions for discussion, and share their knowledge. Very few linked their interest in science to the cause of national rebuilding. They were motivated by practical concerns related to their occupation, interest in a specific question, and a general curiosity for science. They described their relationship to science in terms of interest, passion, and enthusiasm. They referred to the journal using terms such as loyalty, friendship, and support. The letters published positioned readers as knowledgeable even when they were requesting information, and as participants in scientific practice and discourse. The column stopped being published at the end of 1951, but no explanation was offered as to why.[453]

The kinds of letters received and published between 1947 and 1951 had readers contest, correct, or offer additional materials to the articles published. Readers were willing to correct what they had perceived as lacuna or errors in the magazine's articles, indicating their engagement with the journal. Reader Zhang Nenggang 張能剛 who worked at the film department of the Education Ministry in Nanjing (Jiaoyu bu dianying zhipianchang 教育部電影製片廠) wrote to offer a correction to an article published in a previous issue. Zhang's letter was given the title "Introducing Li Hua's Engine Design" (Jieshao Li Hua xiansheng sheji de fadongji 介紹李華先生設計的發動機). By choosing this title, the editors framed the letter as new information worth sharing with their readers.[454]

Zhang Nenggang sent his letter in response to an article published in a previous issue of the journal. The article introduced the Baylin engine, a rotating three-piece engine invented by Canadian Samuel Baylin. Zhang wrote that this engine was "completely similar" to one drawn up by an acquaintance of his, Li Hua 李華 from Jilin. Zhang met Li Hua in Chongqing during the

[453] Readers could still send in questions to the magazine, which were published and answered in a column titled "Shenme, zenme, wei shenme" 什麼，怎麼，為什麼 [What, How, Why?]. The letters were significantly shorter than in the Reader's Letters column. Only the question and the reader's name were printed, and short answers were provided in the following issue. The editors encouraged readers to submit questions about things people encounter in their daily life, "the smaller the scope the better." "Bianzhe shuo" 編者說 [Message from the Editor], *Kexue huabao* 16 no.7, 1950, 309.
[454] Zhang Nenggang 張能剛, "Jieshao Li Hua xiansheng sheji de fadong ji" 介紹李華先生設計的發動機 [Introducing Mr. Li Hua's Engine Design], *Kexue huabao* 13 no.1, 1947, x-3.

summer of 1943. Li had shown him a wooden model of an engine he designed that solved several deficiencies of return engines. His patent application was rejected because the patent office required a metal model. Li was short on funds and could not produce one. In the letter, Zhang wrote that Li's model was not perfect – it was not as efficient as a propeller motor, but its advantage was that it could be made with low grade metal that did not have to withstand high temperature, and therefore was affordable and easy to produce. Zhang concluded that if Li Hua had gotten the patent and were he able to manufacture the motor, it would have made a significant contribution to China's production ability. He did not know the current whereabouts of Li since they lost touch after the war. The veracity of this story remains somewhat blurry, as evidence of a patent application is missing, nor could I find any mention of Li Hua or his engine in other journals and newspapers. The letter, however, represents a contestation to the claim that the rotary engine was a singular invention by a Canadian engineer. It demonstrates the degree to which *Kexue huabao*'s readers saw themselves as participants in the evolving world of scientific inventions, and their confidence in their position as equals vis-à-vis foreign science.

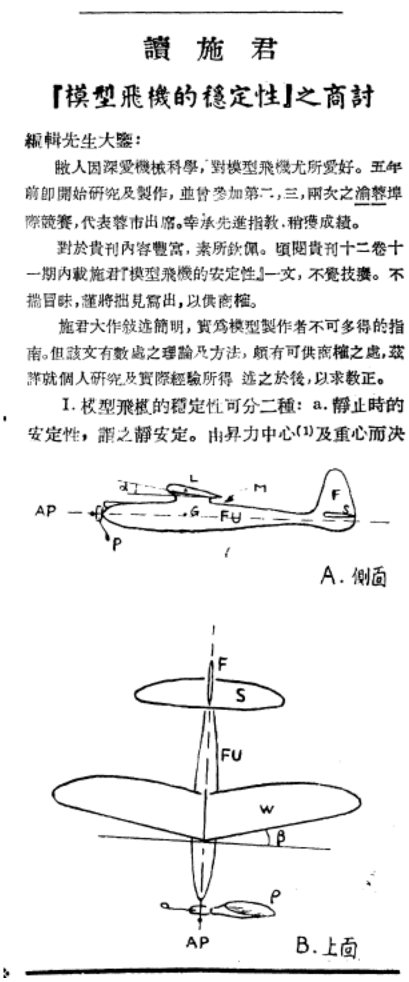
Other letters challenged the magazine's content based on the readers' own scientific knowledge and expertise. Yu Chengzhong 余成忠 a reader who was a student at the Jinling Theological Seminary in Nanjing (Jinling shen xueyuan 金陵神學院), wrote a letter offering commentary on a previously published article about model airplanes. In the letter, Yu first established his credentials for critiquing the article. He was not a professional engineer or scientists, but he "loved mechanics dearly" (*shen ai jixie kexue* 深愛機械科學) and was especially enthusiastic about his hobby of making model airplanes.[455] To support his claim of expertise, he

[455] Yu Chengzhong, "Du Shi jun moxing feiji de wending xing zhi shanglun" 讀施君模型飛機的穩定性之商論 [Discussing Mr. Shi's Article on Stability of Model Airplane], *Kexue huabao* 13 no. 1, 1947, x-5 – x-7.

wrote that he participated twice in the Chongqing-Chengdu model making competition. After reading an article published in volume 12 about model airplanes, Yu was eager to "give it a go" and try the principles outlined in the article. He praised the article for being clear and understandable, but offered corrections based on his "research and actual experience" (*yanjiu ji shiji jingyan* 研究及實際經驗).[456]

Yu established his authority in two ways. First, he foregrounded his hands-on, practical experience. Coupled with his enthusiasm for and love of science, he positioned himself as a legitimate participant in science. We do not know if his vocation was related to science, but his interest in it as a hobby and pastime were explanation enough for why he took time to read the magazine and build model airplanes. Another way Yu established his authority was by replicating the formal characteristics of the articles published in the journal. His letter was accompanied by diagrams he drew to illustrate his discussion of how to determine the center of gravity of a model airplane (Figure 4.2).

[456] Yu, "Du Shi jun moxing feiji."



讀 施 君

『模型飛機的穩定性』之商討

編輯先生大鑒：

敝人因深愛機械科學，對模型飛機尤所愛好。五年前卽開始研究及製作，並曾參加第二，三，兩次之渝蓉埠際競賽，代表蓉市出席。幸承先進指教，稍獲成績。

對於貴刊內容豐富，素所欽佩。頃閱貴刊十二卷十一期內載施君『模型飛機的安定性』一文，不覺技癢。不揣冒昧，謹將拙見寫出，以供商榷。

施君大作敍述簡明，實爲模型製作者不可多得的指南。但該文有數處之理論及方法，頗有可供商榷之處，茲謹就個人研究及實際經驗所得 述之於後，以求敎正。

I. 模型飛機的穩定性可分二種：a. 靜止時的安定性，謂之靜安定。由昇力中心(1)及重心而決

Figure 4.2: Yu Chenzhong's letter, *Kexue huabao* 13 no. 1, 1947

He also provided footnotes to explain some of the terms he used, and included English terms. All of these served as formal markers for Yu's own expertise. Other readers also included diagrams with their letters, a practice that was welcomed and encouraged by editors, even when they were seeking answers to questions. One reader who was a student at Peking University attached a diagram of a question he had about plane geometry.[457] The images provided by readers helped the editors increase the overall number of visuals in the magazine at little expense. But they were also a way for readers to present themselves as science practitioners.

[457] Yuan Longwei 袁龍蔚, "Yige jihe zuotu ti" 一個幾何作圖題 [Question about a Geometry Diagram], *Kexue huabao* 13 no.4, 1947, 213.

Some readers established scientific expertise by engaging directly with authors and starting conversations about topics they were interested in. The reader Shi Guang 史光 from a town near Neijiang 内江 in Sichuan province wrote a letter addressed to Zeng Zhaolun 曾昭掄, a professor at Peking University's Chemistry department. Zeng was an important figure in China's Chemistry world, but he also wrote widely in general publications and weighed in on questions relating to science and society.[458] This may explain his willingness to address Shi Guang's questions. Shi wrote to discuss his thoughts after reading Zeng's book on nuclear energy. Specifically, he was interested in the possibility of producing energy from the sun. He included a quote from Zeng's book about the potential of solar energy, stating this observation was "accurate" (*hen dui de* 很對的), and asserting he completely agreed with the author. Shi had not written a book about atomic energy, but this way of writing suggested his appraisal of Zeng was valid.[459]

Shi explained that he had spent the last two years researching new methods of salt production, which sparked his interest in the sun as a source of energy. He explained his idea – collecting solar energy using a convex condensing lens (*juguangjing* 聚光鏡) and storing it in a special kind of battery. Shi also suggested that in the next edition of Zeng's book, the author should include a specialized and in-depth section on optics, to help generate new ideas. Furthermore, Shi took it upon himself to attach a detailed explanation of the principles of producing solar energy, which the editors printed in full. Zeng Zhaolun responded to the letter in a way that validated Shi's

[458] Reardon Anderson, *The Study of Change*, 187-189.
[459] Shi Guang 史光, "Li yong taiyang de neng keneng ma?" 利用太陽的能可能嗎 [Is it Possible to use the Sun's Energy?], *Kexue huabao* 16 no. 1, 1950, 310. The book in question was Zeng Zhaolun 曾昭掄, *Yuanzi yu yuanzi neng* 原子與原子能 [Atoms and Atomic Energy] (Beijing: Sanlian Publishers, 1950).

suggestion: he stated it was similar to others' ideas, but the problem was that no one was able to construct a financially viable way to execute it. Nevertheless, he wrote, the fact that solar energy had not been produced yet did not mean it would never happen.[460]

Reader Lin Zixiu 林子修 from Shanghai also responded to an article in a letter that was titled "Evaluating the Baylin Engine" 評倍靈發動機. Lin, an accountant at the Shanghai based Datong Coal Company, was an avid reader of the magazine, and had also participated in the Reader's Club. In the letter, he asked about the size and shape of the Baylin engine's valve, and attached several diagrams comparing different possible configurations of a valve. The author of the article in question responded to Lin's letter, and Lin sent in another letter with follow up questions.[461]

Many letters came from readers that saw scientific knowledge as necessary for their vocation. One reader had a small brewery that relied on "traditional methods" (*gufa* 古法). He asked for suggestions for modern ways of producing alcohol. Another reader worked for a sodium bicarbonate manufacturer, and inquired about a new method of production.[462] Even when readers sought advice or consultation, they often foregrounded their own background in and knowledge of science. A reader whose hometown was in a cotton producing area north of the Yangtze River wrote a letter asking about pesticides. The reader, Xu Chanlin 徐產琳, relayed his experience with a strain of cotton seeds introduced from the United States (Deltapine cotton, *dai zi mian* 岱字棉), writing that it appeared to attract more pests. [463] Xu had identified the kinds of pests that impacted

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[460] Shi Guang, "Li yong taiyang."
[461] Lin Zixiu 林子修, "Ping Beiling fadongji" 評倍靈發動機 [Evaluating the Baylin Engine], *Kexue huabao* 13 no.9, 1947, 606.
[462] "Duzhe xinxiang" 讀者信箱 [Readers' Letters], *Kexue huabao* 15 no.8, 1949, 245.
[463] Xu Chanlin, "Dai zi mian haichong de sha zhi" 岱字棉害蟲的殺治 [Exterminating Pests in Deltapine Cotton], *Kexue huabao* 14 no.8, 1948, 455.

the crops and suggested that it may be because Deltapine cotton had plumper leaves and tender branches. He found that powdered D.D.T was not efficient in exterminating the pests and asked for suggestions. Even though Xu related to the journal as an authority on science, he displayed his own knowledge of pests and agriculture.

Readers sent in letters that turned the column into an open arena for different kinds of requests, not strictly a place where the editors answered questions. Xia Yu 夏育, a reader from Nantong city in Jiangsu wrote a letter that was addressed to the community of readers, rather than the editors. Xia described himself as a "good friend" of the journal (*liang you* 良友), and was particularly interested in researching "simple mechanics".[464] He developed plans for reducing oil consumption in carburetors, but because he had no outside guidance, he invited fellow readers to comment and give suggestions on his designs. Another reader, Qu Zuozhi 區佐 described himself as a "science enthusiast" (*zuixin kexue* 醉心科學) who often came up with "small inventions".[465] Qu had an idea for a Chinese typewriter, but because of the war he could not work on it. He read an article published about a new, electric, Chinese typewriter in a previous issue of the journal and realized that its principle was identical to the one he had come up with. The electric typewriter in question was invented by Gao Zhongqin 高仲芹 who worked for IBM in New York.[466] This electric typewriter could produce 5,400 characters using 46 keys. Each character was given a four-number code, and to type a character, the operator would press four keys representing that code.

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[464] Xia Yu, "Tidai qihua qi" 替代氣化器 [Replacing Vaporizer], *Kexue huabao* 13 no.2, 1947, 63.
[465] Qu Zuozhi, "Shenqing zhuanli de shouxu" 申請專利的手續 [How to Apply for a Patent] *Kexue huabao* 13 no.2, 1947, 62.
[466] Hua 華, "Xin shi dianli zidong zhongwen daziji" 新式電力中文打字機 [New Style Electric Chinese Typewriter], *Kexue huabao* 12 no.11, 1946, 529.

This process required the operator to memorize thousands of codes.[467] Inventing a Chinese language typewriter was not just an exercise in engineering, or an opportunity to produce a desired commodity. Thomas Mullaney traces inventors, engineers, and linguists, who were searching for a way to make a character-based script "fit" onto a keyboard. This was a mission of proving that Chinese characters, and therefore the Chinese nation, were compatible with modernity.[468] But it was not only professional engineers that wanted to produce this machine. Qu Zuozhi, who claimed he had come up with a similar system to that of Gao's typewriter, asked the editors about the procedure to apply for a patent.

Readers who were not in the realm of professional science and lacked access to institutional settings such as laboratories, still saw themselves as legitimate participants and inventors. Writing to a magazine, affiliated as it was with the China Science Society and written and edited by scientists, was a way for readers to be part of the scientific establishment, if only at its most outwardly facing level. Eugenia Lean argues that light industry in the early 20th cenury developed in non-professional and seemingly a-political spaces such as the domestic sphere and literati studio, partly because chemical industries were not yet monopolized by the state or by professional scienists and industrialist.[469] The readers discussed in this section are evidence that the increasing professionalization and state control over the production of scientific knowledge did not erase the practice of science in non-official places by people who can be described as amateurs. *Kexue huabao* provided these readers with some access to institutional science, while also legitimating their knowledge-making pursuits in private spaces.

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[467] On operating this machine, see Thomas S. Mullaney, "Meet the Mystery Woman who Mastered IBM's 5,400-character Chinese Typewriter," *Fast Company* May 17th, 2021.
[468] Thomas S. Mullaney, *The Chinese Typewriter: A History* (Cambridge, Massachusetts: The MIT Press, 2017), 124. See chapters three and four on specific systems for Chinese typewriters.
[469] Eugenia Lean, *Vernacular Industrialism*, 8.

The editorial choice to give more space to these readers served the agenda of focusing more on industry and applied science, since these were the topics in which readers (at least the ones who wrote to the journal) were most interested. It was also in accord with directing the journal at a more educated audience, at the expense of accessibility to readers with less background in science. But it also undermined, perhaps intentionally, the divide between the authors and the readers. This signaled a new relationship in which professionals, namely the journal's writers and editors were in conversation with, as opposed to educating, the readership.

My Little Invention

From September 1947, a new column in the magazine presented another way that readers could participate in the journal, this time requiring less expertise and more imagination. The column, titled "My Little Invention" (Wo de xiao faming 我的小發明), showcased reader's inventions and ideas for solving problems using science. The call for submissions invited "imaginative and creative readers to tell us about their own inventions".[470] The editors promised a small writer's fee to those whose letters were published, adding a financial incentive.

In the first appearance of the column, the editors compiled a few inventions that set the tone and signaled the kinds of submissions they were seeking. The entries focused on solving everyday problems. Some of the entries were simple hacks related to everyday objects, for example attaching stickers to each key on a keychain, to make it easy to find the correct one. Other entries suggested new machines, such as a "hand alarm clock", a gadget that would replace the sound of an alarm clock with a mechanical hand to shake the sleeper awake. A somewhat more hazardous innovation was an electric lie-detector, that would send an electric shock when someone was caught lying.[471]

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[470] "Wo de xiao faming" 我的小發明 [My Little Invention], *Kexue huabao* 13 no.9, 1947, 549.
[471] "Wo de xiao faming", 13 no.9, 1947, 549.

The short entries had a lighthearted, entertaining tone, and were accompanied by cartoonish illustrations. A vast majority of the entries did not require knowledge of specific scientific fields or principles. The focus on imagination and creativity in place of concrete methods for building some of the contraptions appealed to an audience different from those who participated in the Reader's Letters column. "My Little Invention" was directed at readers who were less interested in the details of chemical formulae or the nuts and bolts of constructing engines, but were still interested in knowledge that was presented as new and scientific.[472]

Many of the submissions were related to domestic life and to consumer goods available to middle class urbanites and emblematic of their leisure culture. The short submissions followed a similar pattern: the author introduced a problem encountered in daily life, and then presented their idea for how to solve it. Radio sets were common topics, with two readers suggesting there should be a mechanism that automatically turns the radio off, since it was common to fall asleep to its soothing sounds.[473] A reader from Tianjin suggested that those who could not afford to buy ice-skating shoes could fashion something similar by attaching wooden slats to boots.[474] A submission by a reader from Shanghai presented the "common problem" of gentlemen and ladies being dissatisfied with their photographs, because they cannot see what their faces look like while being photographed. His solution was equipping cameras with mirrors, so one can see their own face. This would not only benefit customers but would also increase business for photography studios.[475] In one submission a Hong Kong reader described the vexing situation of having water drip down your arm and into your sleeve while brushing your teeth, a problem especially troublesome during

[472] Eugenia Lean argues similarly that new scientific knowledge in the printed press of the 1910s through the 1930s was read both by fashionable elites and by entrepreneurs seeking practical knowledge. Lean, *Vernacular Industrialism*, 101-106.
[473] "Wo de xiao faming," 14 no.8, 1948, x-5; 16 no.2, 1950, 56.
[474] "Wo de xiao faming," 16 no.1, 1950, 4.
[475] "Wo de xiao faming," 13 no.11, 1947, 671.

winter. His suggestion was to equip toothbrushes with a spherical cap that would stop the water (Figure 4.3).[476] The readers of *Kexue huabao* belonged to a group of mostly urban readers who enjoyed consumer goods and leisure culture.

Figure 4.3: "My Little Invention," *Kexue huabao* 14 no.3, 1948.

Inventions relating to the domestic sphere were also a recurring theme. All the entries were submitted by men, which is not surprising considering the modern configuration of the domestic household, (*jiating* 家庭), had been the subject of scrutiny from politicians and intellectuals since the early 20th century. Knowledge on domestic topics was increasingly professionalized and therefore suitable for men to comment on and participate in.[477] One reader declared that he had designed a rocking bed "to help all mothers and babies." The bed, attached to the ceiling with four ropes, was superior to a mother's arms, because it would not tire.[478] Another reader observed that the busiest time for housewives was making lunch when their children returned from school.

[476] "Wo de xiao faming," 14 no.3, 1948, 136.
[477] Helen Schneider discusses the new field of Home Economics in China's Republican era, a discipline in which both men and women professionalized domestic knowledge. Helen Schneider, *Keeping the Nation's House: Domestic Management and the Making of Modern China*, Vancouver: UBC Press, 2011. See also Lean, *Vernacular Industrialism*, 132-133.
[478] "Wo de xiao faming," 14 no.3, 1948, 136.

Between chopping ingredients and washing dishes, water would be left boiling in the pot (*hu* 壺) for a long time, wasting fuel. The inventor, Ding Yongsheng 丁永生, a student in a Shanghai middle school, suggested that a plug with a small hole in it would produce a whistling sound once the water boiled, thus alerting the housewife it was time to remove the pot.[479] Rocking cribs and whistling kettles were not new inventions. What these readers took credit for was small improvements to existing products, or ways to fashion products at home with common materials.

Some entries displayed a slightly higher level of knowledge. A reader from Changjiang township suggested that those living in the "remote countryside" could install electric doorbell ringers by immersing zinc and copper pieces from old batteries in salt-water in order to re-charge them.[480] Very few submissions were related to labor and production, which also suggests the readership was mostly employed in white-collar occupations. But even those inventions indicate an observer of labor. One reader suggested ways to improve the sturdiness of household spinning machines, while another wrote in with the idea that painters should attach wheels to their ladders, so they do not waste all their energy carrying equipment around before starting their jobs.[481]

Some writers imagined complex machines, but were not particularly technical about how their ideas could be implemented. One reader addressed the problem of pickpockets on buses, suggesting installing an "electric eye" (*dian yan* 電眼) that could detect if someone on the bus was stealing from another passenger. The electric eye would also be equipped with an extending mechanical arm that would grab the thief, making sure they felt the arm of the law.[482] A similar suggestion that also tackled a social problem came from Wu Youxin 吳友信 from Hunan. Wu

[479] "Wo de xiao faming" 14 no.12, 1948, x-4.
[480] "Wo de xiao faming" 15 no.9, 1949, x-4.
[481] "Wo de xiao faming" 16 no.2, 1950, 56.
[482] "Wo de xiao faming" 13 no.11, 1947, 671.

argued that even though opium had been banned, it was still being sold. His invention was a machine that would be installed in high-traffic areas that could detect if a passing car contained crude opium, and alert officers who would then preform a search.[483] These submissions were not concrete proposals for how to build such machinery, but imaginative ideas that rested on a broad perception of technology and how it can be used to solve problems.

When the column was initially published in September 1947, original illustrations accompanied some of the submissions. Some of the images were cartoonish and exaggerated (see figure 4). Even when the illustrations were not comical, they were still not technical diagrams, which indicates that these inventions were rarely seen as concrete plans. They provided a way for readers to exercise creativity and propose clever (or mundane) solutions to daily problems. The entries in "My Little Invention" were different from the Reader's Letters submissions in their tone, intention, and level of expertise. The inventions were more playful, and much less technical. They were not based on specialized, discipline-specific knowledge, which was sometimes seen in the Reader's Letters.

The column stopped appearing in June 1950. The last column featured only one invention, by a reader named Tao Qilu 陶其錄. He wrote that he worked in a big kitchen that feeds 200 people. In the springtime, people want to enjoy a dish of fresh soybeans, but peeling them is very labor intensive. He suggested there should be a machine that would de-shell not only soybeans, but also peas, to make kitchen work more efficient.[484] The editor included an illustration of a similar machine so that readers could try and fashion their own.

[483] "Wo de xiao faming," 13 no.11, 1947, 671.
[484] "Wo de xiao faming," 16 no.5, 1950, 224.

There was no official announcement of the column ending, but an editorial note in the last column provides some clues as to why it was discontinued. The editor asked readers to continue submitting their inventions, but to focus on ones that were realistic and did not veer into fantasy. Editors were seeking inventions and improvements for socialist spaces such as factories and institutional kitchens. Submissions focusing on a bourgeoise leisure and consumer culture were no longer appropriate.

Conclusion

The readers who wrote letters to the journal, took part in the Readers' Club, and sent in their "little inventions" represented a range of interests, motivations, and approaches to science and knowledge. At one end of the scale were readers with a foundation of scientific knowledge acquired in the formal education system, even if this was only at a middle-school level. Readers such as Bian Depei, who became a prolific author of astronomy books for lay audiences; Yang Anding, the Guangzhou University student who wrote an article on balancing chemical equations; Yu Chengzhong, who wrote about his experience with model airplanes; and Shi Guang, who researched salt production and was interested in solar energy, represent a readership that can be referred to as "lay science practitioners." Their engagement with science was done outside of professional, institutional science. Some of the readers were students who had access to laboratories and libraries, but they were not yet full-fledged scientists. The lack of infrastructure did not deter this group, whose members still wanted to "do" science. Some had the resources to buy their own equipment and set up small home laboratories. For others, this was an unobtainable ideal. Nevertheless, these readers found ways to craft drawings, come up with ideas, build models, or tinker with what was available to them. Reading and sending letters to the journal was another avenue that allowed them to participate in making scientific knowledge. The magazine served as a space for these readers to engage with other like-minded "science practitioners" and form a community.

The readers who submitted entries to "My Little Invention" were perhaps less proficient in science. They presented their ideas without specialized terminologies, and their suggestions mostly necessitated objects that were widely available, such as using pieces of wood to fashion ice-skates. Some inventions were purely in the realm of fantasy. The reader who suggested a "mechanical eye" to stop thieves on buses did not refer to any specific mechanism that could make his suggestion real. Choosing cartoon illustrations for this column signaled that the editors viewed these submissions as amusing fare to complement more seriously scientific content. It suggests that some readers continued buying the journal not because they were planning to use scientific knowledge in their work or daily life, but because science was interesting and entertaining. Other studies on journals in Republican-era China similarly point to mixed audiences. Women's journals were often read (and written) by men.[485] Recipes for cosmetics and knowledge on industrial production were consumed by genteel women, literati men, and budding entrepreneurs.[486] Even as *Kexue huabao* focused on more technical and specific knowledge, and featured less basic, introductory articles, there was an attempt to appeal to readers seeking entertainment alongside new kinds of knowledge.

The change in the dynamic between the publisher and editors, and the readers, was part of a broader consideration of the function of science popularization after the end of the Japan's occupation of China. The Guomindang's rebuilding agenda focused heavily on training students in applied science and increasing China's production capacity. Within the professional scientific

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[485] Judge, *Republican Lens*, 66-69.
[486] Lean, *Vernacular Industrialism*, 104-106; 144-145.

community, there were competing views: some believed theoretical science deserved more resources, and others viewed theory and applied science as complimentary, rather than contradictory. These debates trickled into the editorial room and the pages of the magazine, and impacted the decision to cater directly to a more educated audience.

Giving these readers more space in the journal served both the agenda of this group of readers, and of the editors. The readers gained more opportunities to participate in the magazine, form a community, and receive some acknowledgement for their engagement in science. The editors were able to say that publishing more advanced articles was to satisfy the needs of readers. At the same time, they insisted they would continue to provide basic introductions for less educated readers. These, however, became less common in the journal after 1947. The trend of focusing on a more educated audience continued into the 1950s, albeit with a short detour between July and December of 1950.[487] Concerns over how to define the appropriate audience for the journal, and what kinds of knowledge these audiences needed were critical to the journal's editors during the late Republican era and into the Communist era.

[487] There is evidence to suggest that even after the journal was taken over by the Shanghai Science Dissemination Association in 1953 the editors continued to target educated readers. full discussion of the journal post-1953 is beyond the scope of this dissertation.

Chapter 5: Re-making the World of Science

Introduction

The establishment of the People's Republic of China in October 1949 resulted in a mix of continuity in some areas of the journal and change in others. The period between 1949 and 1952, when the China Science Society started to transfer its assets and operation to newly established government organs, was a period of re-organizing. However, there were several important underlying continuities that reflect the enduring commitments of the magazine. The chapter examines this period through three angles: the magazine's editorial shifts; its definition of its audience in this new era; and its engagement with foreign science.

From an institutional perspective, continuity was maintained throughout the first years of the PRC, but the journal was gradually integrated into state organs of science dissemination. However, this was not a top-down process that compelled the journal's editors to change their publication. Leaders of the China Science Society and the journal's new editors served in key positions in newly established organizations of science dissemination. They were part of shaping science popularization in China's socialist era, and the changes in *Kexue huabao* reflected policies similar to those adopted by state agencies.

Kexue huabao continued its publication under the China Science Society until the end of 1952. However, a critical change was the resignation in 1950 of Yang Xiaoshu 楊孝述 (1884-1974), the magazine's founder, publisher, and editor-in-chief since 1933. He was replaced not by an outsider, but by long time society member and contributor to the journal Zhang Mengwen 張孟聞 (1903-1993). Lu Yudao 盧于道 (1906-1985), another longtime contributor and editor of the journal, also remained on its board until 1952. In 1953 the editorship of the journal was officially transferred to a new organization, of which Lu Yudao was the chair – the Shanghai Science and Technology Dissemination Association (Shanghai shi kexue jishu puji xiehui 上海市科學技術普及協會, hereafter Shanghai Science Dissemination Association).

The most drastic changes in the journal were the ones made with regards to the audience, but these were ultimately retracted. As the new regime took shape, the magazine's editors had to redefine who science was for, and what types of scientific knowledge citizens needed. Under socialist rule, however, the answer to the question of audience was different. The first editorial published after communist troops had taken over Shanghai, in July 1949, declared that "science belonged to the people" (*kexue shi shuyu renmin de* 科學是屬於人民的).[488] The category of "the people" was increasingly salient in the People's Republic of China, and its meaning had political significance that could impact an individual's fate.[489] Under socialism, citizens were categorized according to their class status, and the people, or "the masses", were those who belonged to the revolutionary classes, namely workers, peasants, and soldiers.[490] Political and theoretical configurations of the people that set the tone for literature and arts were likewise adopted by science popularizers. Science disseminators relied on Mao Zedong's speeches on how intellectuals should approach their mission of creating works for the masses.[491]

[488] "Zai Shanghai jiefang de yi yue" 在上海解放的一月 [One Month after Shanghai's Liberation], *Kexue huabao* 15 no. 5-6-7, 1949, 188.
[489] Michael Schoenhals, "Demonizing Discourse in Mao Zedong's China: People vs Non-People", *Totalitarian Movements and Political Religions*, 8 no.3-4 (2007): 465-468.
[490] These categories were not clear-cut and objective, and elements such as finances, landownership, urban or rural residence all played a part in defining an individual's status. These definitions also changed over time, but were generally linked to Mao Zedong's understanding of revolution. See Stuart R. Schram, "Classes, Old and New, In Mao Zedong's Thought, 1949 – 1976," in *Class and Social Stratification in Post-Revolution China,* ed. James L. Watson (Cambridge: Cambridge University Press, 1984), 29-31; Paul Healy, "Misreading Mao: On Class and Class Struggle," *Journal of Contemporary Asia*, 38 no.4 (2008): 537 – 540.
[491] Sigrid Schmalzer, *The People's Peking Man: Popular Science and Human Identity in Twentieth Century China* (Chicago: The University of Chicago Press, 2008), 115-116.

The political shift in the meaning of "the people" caused a radical shift in the journal's target audience, and therefore in its tone and style. In a sharp break with their previous audience of educated lay science practitioners, from July to December of 1950 *Kexue huabao* attempted to cater to a readership which better suited the socialist notion of "the people". Taking their cue from Mao Zedong's assertion that literature and art should serve the people, the magazine declared it would now be addressed to "the masses of workers, peasants, and soldiers" (*gong nong bing dazhong* 工農兵大眾).[492] However, this change was short lived, and from January of 1951 onward the editors returned to directing the magazine's content to a more educated audience, resuming the trend which had begun in 1947. These swift changes demonstrate that the early years of the People's Republic of China were not a decisive break from the past determined by rigid ideology, but a period of experiments and instability, even in terms of class politics.

Another theme which continued to be significant to the editors was engagement with an international community of science. From its establishment and throughout the 1940s, the journal used various British, American, French, and Japanese magazines, books, and textbooks. Foreign materials were sometimes directly translated, but more often edited and compiled into new articles. Relying on foreign publications for content and images was partly driven by necessity, especially in the first decade of the journal's publication, when domestic scientific institutions were only beginning to produce original research.[493] But it was also part of the journal's editorial agenda: the writers, editors, and publisher of *Kexue huabao* saw science as an inherently transnational endeavor. After 1949, foreign science was still featured in the magazine, but the rise of socialist

[492] "Xin kaichangbai" 新開場白 [New Introductory Remarks], *Kexue huabao* 16 no.4, 1950: 165.
[493] James Reardon Anderson, *The Study of Change: Chemistry in China, 1840 – 1949* (Cambridge: Cambridge University Press, 1991), 255-257.

politics and Cold War alliances meant that "the world of science" was now interpreted as China, the Soviet Union, and communist allies.

Institutional Transformation

In March 1950 the magazine's founder, publisher, and editor-in-chief Yang Xiaoshu resigned. The journal went on a three-month hiatus, but when publication renewed in July of 1950, it was a different journal. It is unclear whether Yang chose to resign or was forced out, but stepping down from his position was politically-driven and explained by the journal's perceived inability to reach the masses. The journal's new editors claimed that *Kexue huabao*'s success had been limited because it only reached an audience of petty bourgeoise. [494] In a written "self-criticism" that was published in July 1950 and attributed to the editorial board, the magazine's print run was divided into three periods. [495] Between 1933 and 1937, the editors wrote, the magazine accomplished its objective of appealing to "the people", even if this did not include peasants and workers. Between 1937 and 1945, it managed to stay in print despite the war, and was therefore patriotic. However, the period from 1945 to March 1950 was a period when "success was limited and flaws were countless."[496] The historical perspective forged by the editors can be seen as an attempt to balance the accomplishments of the journal with its failings in order to keep the magazine in print. As the publisher and editor-in-chief, Yang Xiaoshu would be the one responsible for its shortcomings.

Yang's notice of resignation was a short paragraph printed towards the end of the March 1950 issue. In it, Yang took responsibility for the journals supposed shortcomings. He expressed regret for not being able to achieve the journal's ideal of widely disseminating science, and that

[494] "Xin kaichangbai", 165.
[495] "Women de ziwo jiantao" 我們的的自我檢討 [Our Self-Criticism], *Kexue huabao* 16 no.4, 1950, 185.
[496] "Women de ziwo jiantao," 185.

the readers did not have more say in the publication. In the new era of the people, Yang wrote, the magazine's mission of science popularization was even more important. Because of his old age, he did not feel up to the task, and therefore decided to hand in his resignation. Yang introduced the new editor, Zhang Mengwen, who was familiar to long time readers since he had written several articles for the journal.[497]

Despite Yang Xiaoshu's leading role in promoting science popularization at the China Science Society, he did not join the new regime's organizations for science dissemination. After resigning from *Kexue huabao* and from his role as secretary general of the China Science Society, he was head engineer for an electric furnace manufacturer, Xinhua dianlu chang (新華電爐廠).[498] He did not become a party member, but in the 1950s he participated as delegate in allied organizations, such as the Yangpu district branch of the People's Political Consultative Conference.[499] Yang headed some of the commercial aspects of the China Science Society, as publisher of *Kexue huabao* and general manager of the China Science Corporation. This may have impacted his class status after 1949, and his resignation was probably a result of his political designation. Under the new political circumstances, it is possible that *Kexue huabao* could only continue its publication without Yang as editor-in-chief. During the Cultural Revolution Yang was labeled anti-revolutionary and was targeted by Red Guard groups. He passed away in 1974, and was officially rehabilitated in 1981.[500]

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[497] Yang Xiaoshu, "Bianzhe de hua" 編者的話 [Editor's Remarks], *Kexue huabao* 16 no.3, 1950, 161.
[498] Some sources credit Yang with founding the company, while others claim he was head engineer. Yang Wen 楊文, "Yang Yunzhong yu Zhongguo kexue she" 楊允中與中國科學社 [Yang Yunzhong and the China Science Society], in *Shanghai wenshi ziliao xuanji* ed. Shanghai shi zhengxie wenshi ziliao bianjishe (Shanghai: Shanghai shi zhengxie wenshi ziliao bianjishe, 1992), 288-291.
[499] Cheng Xinguo 程新國 ed., *Shanghai dashi: Zhongguo xiandai kexue dianjizhepinzong* 上海大師中國現代科學奠基者萍蹤 [Great Teachers of Shanghai: Traces of China's Modern Science Pioneers] (Shanghai: Shanghai kepu chubanshe, 2007), 177.
[500] Yang Wen, "Yang Yunzhong," 290-291.

Even before Yang's official resignation, there were signs that the editors were considering how to adapt the journal given the new political landscape. Science popularization was an important priority for the new communist leadership, but it came with a built-in tension. On the one hand, the socialist agenda was to learn from the masses, an imperative that necessitated valuing local practices and knowledge. On the other hand, bringing science to rural areas was predicated on viewing those practices, or at least some of them, as superstitious and backwards.[501] These tensions were evident in *Kexue huabao*'s negotiation of its audience and the question of who has access to scientific knowledge.

In the opening editorial of volume 16, published in January 1950, Lu Yudao wrote that the magazine's original mission – to bring common scientific knowledge to the people – was still relevant. However, he emphasized that knowledge should not be monopolized and kept within the realms of academia and industry. Rather, the "garden of science" (*kexue de yuandi* 科學的園地) should be opened to the people. Although the magazine has not yet succeeded in this mission, Lu wrote, it also never engaged in monopolistic behavior.[502] Even though Lu acknowledged the importance of access to scientific knowledge, his words maintained the hierarchy of experts and novices in making scientific knowledge. To use his metaphor, professional scientists and experts were the ones who planted the garden, while the general, non-expert public would be visitors in it. The journal's approach to its new readers – the masses – positioned them at the receiving end of knowledge production, rather than allowing them a real role in creating new scientific knowledge.

Lu's assertion that the journal – and its editors – did not monopolize knowledge served as a cautiously optimistic assessment of *Kexue huabao* and indicated that the editors wished to see

[501].Schamlzer, *The People's Peking Man*, 125-136.
[502] Lu Yudao, "Juantou yu" 卷頭語 [Opening Issue Remarks], *Kexue huabao* 16 no.1, 1950, 6.

the publication resume under the new regime. However, they were also aware that they would need to reconsider how they would proceed. Lu also wrote that the magazine was not thinking of these questions completely independently. *Kexue huabao* was now part of the nation-wide work of science dissemination.[503] This claim was not just a rhetorical gesture. Over the next two years, the journal became increasingly connected with the party-state institutions of science dissemination.

Soon after the establishment of the People's Republic, the work of science dissemination was incorporated into state organs. In November 1949, a science dissemination office (*kepu ju* 科普局) was established as part of the Culture Bureau. In August 1950, the National Association for the Dissemination of Science and Technology (Quanguo kexue jishu puji xiehui 全國科學技術普及協會, abbreviated as *kepu xiehui* 科普協會, hereafter Science Dissemination Association) was officially established.[504] The national association mandated that every provincial capital should have its own branch of the association. *Kexue huabao* had intimate links to the Science Dissemination Association: Zhu Kezhen 竺可楨, one of the founding members of the China Science Society, was its vice-chair, and Lu Yudao and Zhang Mengwen were members of the standing committee.[505] When the Shanghai branch of the Science Dissemination Association was established in November 1950, Lu Yudao was elected as its chair, and Zhang as vice-chair. Several of the writers who contributed to the magazine were members of the publication committee of the Shanghai Science Dissemination Association.[506]

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[503] Lu, "Juantou yu,"6.
[504] Science dissemination was backed and sponsored by these state associations, but it was also diffuse in execution of programs, and encompassed different actors. See Schamlzer, *The People's Peking Man*, 63-64.
[505] Yin Gongcheng 尹恭成, "Cong kelian, kepu chengli dao zhongguo kexie yida zhaokai" 從科聯、科普成立到中國科協一大召開, *China Historical Materials of Science and Technology* 9 no.1, (1988): 68-70.
[506] Shanghai shi kepu xiehui gongzuo zongjie ji gongzuo baogao 上海市科普協會工作總結及工作報告 [Shanghai Science Dissemination Association Work Summary and Report], January 1952. Shanghai Municipal Archive, C42-1-20.

Kexue huabao Turns to the People

The three-month hiatus in *Kexue huabao*'s publication after Yang's resignation roughly corresponds to the period before the Science Dissemination Association held its official plenary meeting in August 1950. Although the magazine resumed its publication earlier, in July of 1950, we can assume that its editors were involved in preparatory meetings and discussions about the association's goals and plans. In August 1950, the National Science Dissemination Association outlined four goals for science popularization: to ensure workers grasp production technology and to promote scientizing production; to eradicate superstition by explaining the correct scientific view of natural phenomena; to promote the inventions and scientific achievements of Chinese workers; and to disseminate knowledge on medicine and hygiene.[507] The first two goals had a clear audience – workers and "the masses," which although not identified directly, were presumed to be those who held superstitious views. The association's goals focused on "useful" knowledge that closely mirrored class expectations. Technical knowledge to help workers be more productive was the first goal, and replacing superstition with "correct" scientific knowledge, the second.

Scientific knowledge was not a neutral category, but was linked to class identity and the definition of different groups of citizens. The previous regime defined "common scientific knowledge" in terms of citizenship. The new science popularization organs were concerned with how to match scientific knowledge to class. When the magazine returned to print in July 1950, the editors penned a "New Introductory Remarks" introducing the new guiding principles of *Kexue huabao*. Recalling the journal's opening editorial of 1933, the editors noted that from its inception, the journal's mission was to spread scientific knowledge and science news to the people. However, in the past, reaching an audience of educated elites was an acceptable measure of success. But now

[507] Yin, "Cong kelian," 68.

that “the people have risen”, this was no longer a sufficient aspiration.[508] The editors decided that *Kexue huabao* should be aimed at workers, peasants, and soldiers, referencing Mao’s configuration of who constituted the masses. The principles that followed offer an overview of the kinds of knowledge the editors thought that peasants, workers, and soldiers needed, as well as how best to reach these audiences.

In the “New Introductory Remarks”, the editors emphasized that images should reflect “the people’s” living conditions, and not require further explanation. Images were always part of the journal’s method of educating its readers, but now they were meant to reflect the people’s lived reality and be easily understood, without requiring additional, textual, explanations.[509] Articles should focus on practical matters and be written simply, avoiding an overtly didactic tone. Most notably, the journal adopted new styles of writing that could serve cadres in transmitting knowledge to illiterate audiences. These included articles written in the form of ballads, comic dialogue, *kuai ban* (“Clapper Talk,” 快板), plays, and illustrated serial narratives (*lianhuantu* 連環圖).[510] The editors believed that using these forms would draw in the masses and make science more appealing to them. But using formats that were meant to be delivered orally, or relied on visuals, was also a way of reaching mostly illiterate workers, peasants, and soldiers.

A small decorative image that accompanied the editorial announcing the changes indicated a mixed approach to what kinds of knowledge were considered necessary. The image, of unknown origin, depicted a farmer holding a young calf, standing in a field (Figure 5.1). In the top part of the image, where a sun may have been, was an illustration of an atom – a small dot representing

[508] “Xin kaichangbai,” 165.
[509] Xin kaichangbai, 165.
[510] Xin kaichangbai, 165. Kuai ban is a form of rapid tempo storytelling, where the performer often accompanies themselves with wooden clappers.

the nucleus, surrounded by oval spheres representing the movement of charged particles. Knowledge for peasants under the new socialist regime was not limited to agriculture, hygiene, pest control, or nutrition. Nuclear energy and the atomic bomb were also in the realm of necessary and relevant knowledge.[511]

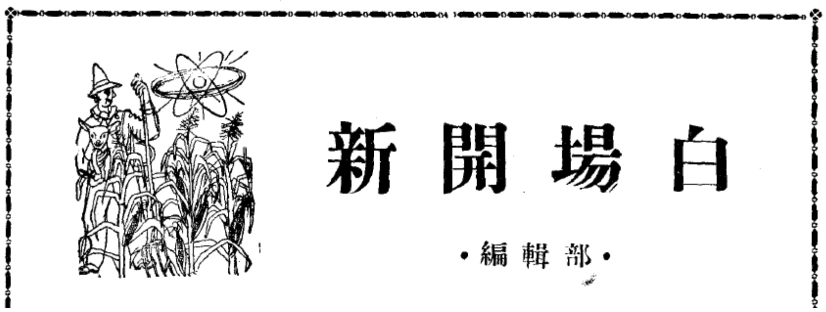

Figure 5.1: New Introductory Remarks, *Kexue huabao* 16 no.4, 1950.

The remaining issues of volume 15, published between July and December 1950, adhered to the new principles by adopting the new recommended genres and by publishing articles with knowledge that was meant to be relevant to peasants and workers. Some of the pieces published in the magazine could be delivered orally, so that they could be read to illiterate audiences. The topics discussed conveyed the kinds of knowledge the journal thought workers, peasants, and soldiers should have. Many of the pieces written in the rhymed poem or dialogue genre had the intention of showing peasants and workers how science could improve their lives. Common topics were basic hygiene and medicine, with a particular emphasis on cholera; pests and pest control; and factory safety. Images also attempted to reflect the new audience. The cover of the issue

[511] Matten discusses representations of the atom in the PRC in the 1950s, arguing that the threat of atomic weapons during the Korean War made these topics priorities in disseminating science. Marc Andre Matten, "Coping with Invisible Threats: Nuclear Radiation and Science Dissemination in Maoist China," *East Asian Science, Technology and Society: An International Journal* 12, no. 3 (September 1, 2018): 239 - 244.

published in August 1950 featured an illustration of three peasants – a man, woman, and child, together with a soldier and cadre, swatting locusts in a field (Figure 5.2).

Figure 5.2: Cover, *Kexue huabao* 16 no. 5, 1950.

Some of these pieces described peasants as superstitious and resistant to modern medicine. The dialogue "Have You Gotten Vaccinated?" featured two characters labeled A and B discussing hygiene, medicine, and superstition.[512] The images accompanying this piece provided illustrated context for the dialogue, showing a man passing through a crowd gathered to listen to a speaker. A woman wearing a long coat and surgical mask – a nurse – gestured to the man to stop him. A banner behind the crowd had the words "the danger of cholera" (*huoluan weixian* 霍亂危險) (Figure 5.3). The woman and the man represented the two characters in the dialogue. Character A, the nurse, asked B if he had gotten a vaccine. B lied at first but then admitted he had not, saying that getting cholera was a matter of fate. To this, character A responded with a dismissive "so superstitious", explaining that germs, and not spirits looking for revenge, cause diseases. Character

[512] Xu Tian 許天, "Ni da le fangyi zhen meiyou" 你打了防疫針沒有 [Have You Gotten Vaccinated?] *Kexue huabao* 16 no.4, 1950, 179 – 181.

B had never heard of germs, but after an explanation from A, and an explanation of how vaccines work, he was ready to get vaccinated, saying that only a fool would not agree to a shot. The last illustration depicted character B with his sleeve rolled up, getting a jab.[513]

Figure 5.3: Detail from "Have you Gotten Vaccinated?," *Kexue huabao* 16 no.4, 179.

The visuals accompanying the dialogue demonstrate the ways in which the editors attempted to have images reflect the lives of the people more closely. One image explained the measurement unit of a cubic centimeter (c.c, glossed as *xixi* 西西 in the article), through an illustration that showed how many cubic centimeters were in a spoon commonly used as a utensil alongside chopsticks. "An ordinary spoon" the caption read, "holds 15 C.C.".[514]

One *kuai ban*, a quick-tempo rhymed poem with seven characters per line, titled "Li Xiao'e Sees a Doctor" (Li Xiao'e kan bing 李小娥看病), was about the superiority of modern biomedicine, and contained information on hygienic practices. The *kuai ban* described the Li family who were working in the field during harvest time. They dug a latrine hole and a water hole to drink from, but did not maintain proper hygiene: the two holes were too close together, and the latrine was not covered. They also did not wash their hands before eating.[515] Xiao'e, one of the

[513] Xu Tian, "Ni da le," 181.
[514] Xu Tian, "Ni da le." 180.
[515] Ji He 吉訶, "Li Xiao'e kan bing" 李小娥看病 [Li Xiao'e Goes to the Doctor], *kexue huabao* 16 no 5, 1950, 228.

daughters, was described as a ruddy faced hard working 20-year-old woman, who one day fell ill, lost her appetite and was bed ridden. The poem describes various methods used to treat her, all of which were based on traditional medical practices and beliefs. The first doctor diagnosed Xiao'e by taking her pulse. He prescribed an herbal remedy, and later poked specific areas of her body to draw blood. After these methods did not work to improve her symptoms, the family was desperate and called a village woman who practiced Buddhist rites. The woman's herbal concoctions, obtained by communicating with immortal spirits, did not work either and Xiao'e was getting worse. Finally, the village cadre arrived and suggested taking her to the hospital. Her parents took her to the hospital, where the doctor asked to admit her. The family was resistant at first, but the doctor explained the benefits of being in the hospital: they could monitor her situation, the conditions were more sanitary, and nurses would be available to take care of all the patient's needs. The parents agreed and she was admitted to the hospital, where she got medicine and shots. After a few days, her health improved. The family returned with the healthy Xiao'e to their village, where they told everyone about how well the government was taking care of the people.[516]

In addition to adopting folk genres, the magazine's editors used images which reflected the lives of the people they saw as their target audiences. The images in the magazine were supposed to assist in connecting the content of the articles to the "realities of (the people's) lives" (*yu shiji shenghuo xiang lianjie* 與實際生活相連結).[517] This was done by illustrating scenes and objects that were familiar to peasants. In a rhymed dialogue titled "cotton" (*mian hua* 棉花), one character was demonstrating to the other the myriad uses for, and importance of, cotton. The article was accompanied by several types of visuals. Drawings of items made of cotton, such as a towel, socks,

[516] Ji He, "Li Xiao'e," 229.
[517] "Xin kaichangbai," 165.

cotton shoes, and a “liberation suit” (*jiefang zhuang* 解放裝, later known as a Mao suit) illustrated the ubiquity of cotton in daily life.[518] Other images included illustrations of different kinds of weaving machines, and a drawing of two types of cotton flower. The illustration highlighted the differences between the two kinds, particularly in the shape of their leaves, reducing the need for explanatory annotations. Even the more “scientific” visuals were relatively straight forward. These included a photograph comparing the fibers of three types of cotton, a close-up photograph comparing the size of an American cotton boll with a local cotton boll, and a photo of a Chinese scientists examining cotton fibers.[519] Although the different images were all captioned, none of them required special explanations. There were no cross-section representations, anatomical illustrations, or microscopic images. Rather, all the images “read” easily as different kinds of cotton.

Another genre introduced under the magazine’s new principles was the illustrated narrative. Illustrations were the main component of these pieces, but each figure was accompanied by three to five short sentences. The topics were meant to be relevant to workers or peasants, and the illustrations, drawn by the journal’s staff, were meant to convey scenes that were familiar to these groups. For example, a piece titled “Preventing Mole-Crickets and Defending Wheat Seedlings” was aimed at peasants, and contained eight large, illustrated panels printed across two pages, and an introductory paragraph.[520] It was published in the October issue, to coincide with crop planting for spring. In the introduction, the author explained the havoc mole-crickets wreak on wheat fields: they ravage wheat seedlings, and the tunnels they dig underground prevent proper water retention

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[518] Liu Peiheng 劉佩衡, “Mian hua” 棉花 [Cotton], *kexue huabao* 16 no.4, 1950, 168 - 171.
[519] Liu Peiheng, “Mianhua,” 171.
[520] Zhang Xuezu 張學祖, “Fangzhi lougu baohu maimiao” 防治螻蛄保護麥苗 [Preventing Mole-Crickets and Defending Wheat Seedlings], *Kexue huabao* 16 no.7, 1950, 290-291.

and collapse the soil. Helpless against these pests, the author wrote, some people fall prey to superstition, believing spirits can control crop outcome. Instead, the article suggested different methods that farmers can use to stop mole-cricket infestation, such as mixing arsenic-laced grains with the seeds that are being sown, or digging a hole and filling it with moist livestock excrement to serve as a trap for the pests, then killing them manually once they enter it.[521]

The illustrated panels focused on depicting rural life and labor. The characters were two farmers, one male and one female. The objects surrounding them were simple, daily items such as baskets, wooden stools, and hoes. One panel showed two kinds of mole-crickets, a larger one common in Northern China, and the smaller, African mole-cricket, common in the south. Other than this panel, all other illustrations of the pests placed them within fields, showing their underground tunnels in relation to planted crops (Figure 5.4).

Figure 5.4: "Preventing Mole Crickets" *Kexue huabao* 16 no.7, 290.

[521] Zhang Xuezu "Fangzhi lougu," 290 – 291.

Like the illustrations of the varieties of cotton, the imagery of the specimen in question was meant to be easily read, without needing additional apparatus such as labels, which were common in anatomical drawings. The illustrations of the methods to exterminate the pests were meant to represent rural life in China. However, the images alone did not fully explain the procedures suggested. The captions accompanying each panel provided a more detailed explanation of the methods. Illiterate audiences could not do much if they relied only on the illustrations, but the illustrated serial narrative could be read aloud to an audience. The text was more suitable for an audience with at least an upper primary education, but the images were meant to seem familiar and approachable to rural audiences.

Reader's Participation

The attempt to be more accessible to the masses did not mean that these new audiences had an actual voice in the pages of the magazine. The space for reader contribution in the journal shrank, and the kinds of participatory columns differed from the pre-1950 ones. Starting in 1947, the Reader's Letters column usually took up five to six pages. Letters often discussed the readers' own scientific experiments, posing questions on science either to experts or to fellow readers. In this way, the editors of *Kexue huabao* acknowledged that their readers were members of a community that created scientific knowledge. In the issues published from July until December of 1950, there was a steady decline in the number of pages dedicated to reader's letters, and in the kinds of letters that were encouraged by the editors. Starting August 1950, the column was cut to one page. In 1951, the column appeared only sporadically, until it was eventually discontinued, with no explanation, in 1952.

From July 1950 onward, the editors selected letters that mirrored more closely the kinds of new audience they were targeting. However, since sending in a letter to the magazine required above basic literacy and access to the journal and writing supplies, readers who sent letters were still mostly urban residents with some degree of science education. Through a process of selecting the most appropriate letters, the editors attempted to signal which readers should participate, and in what ways.

In July 1950, the column's four pages contained three letters from readers, all of them regarding agriculture. Since the journal was on hiatus for three months before the July issue, letters from readers probably accumulated, allowing the editors to choose the ones they wanted to print. Therefore, selecting three letters that were about agriculture can be read as intentional. However, the writers of these letters were not representative of the masses of peasants the journal had begun targeting. One letter was from Li Hongye 李宏業 from Hong Kong, who identified as "engaged in agriculture" (*congshi nongye* 從事農業). Li grew fruit trees, vegetables, and melons, and had rice paddies and chicken.[522] Li asked for a formula for pesticide that would be suitable for vegetables, and inquired about how to obtain specific chemicals in Hong Kong. He also sought clarification on an unfamiliar term – Cyclohexanone (Huansitong 環巳酮) – that he encountered while reading about solvents for DDT.[523] His questions demonstrated both a high degree of literacy and some facility in chemistry. The other letters that appeared alongside Li's also focused on practical matters relating to agriculture, and were also written by readers with a knowledge of scientific principles.

In August 1950, the column contained two letters, both from workers. One letter came from Zhang Xuan 張軒 who worked in the X-ray laboratory of a Nanjing hospital, asking how to safely

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[522] Li Hongye 李宏業, "Cai chong yao he di di ti" 采蟲藥和滴滴涕 [Pesticide and D.D.T], *Kexue huabao* 16 no.4, 1950, 199.
[523] Li, "Cai chong yao," 199.

store the film on which X-ray images were printed.[524] The other letter was from Kang Yinfu 康銀福 from the Pudong Gongmao shipyard, who asked a series of questions on the horsepower of engines.[525] In the remaining four issues published in 1950, most of the letters came from workers in factories and several from soldiers.

The editors wanted to encourage their new audience to write letters, but at the same time these new audiences represented groups who were less literate and had less access to mail than urban residents. In October 1950, the Readers' Letters column featured two questions from soldiers. However, the letters themselves were not printed – only the editor's response. This could have been due to page limit constraints since the column was cut to one page. But a more skeptical interpretation is that these letters were fabricated by editors in order to demonstrate the kinds of letters they wanted to receive. The content of the editor's response strongly suggests that they were trying to make a point about the kinds of submissions they were seeking. One soldier asked whether he could submit an article on electric engineering. The editor responded that they would be happy to receive articles from readers based on experience, and that had practical use (*shiji yongtu* 實際用途).[526] The second response read as follows:

"To Jiaodong region liberation army soldier, comrade Xu Lizhong: we have received your question and sent it to an expert for response. We hope to print it in the next issue. You wrote that due to your low level of scientific knowledge, your question may be too ignorant. This statement

[524] Zhang Xuan 張軒, "Zenyang baocang X guang ruanpian" 怎樣保藏 X 光軟片 [How to store X-ray film], *Kexue huabao* 16 no.5, 1950, 238.
[525] Kang Yinfu 康銀福, "Yinging de mali, yinqing de zhuanshu" 引擎的馬力，引擎的轉數 [Engine's Horsepower and Revolutions], *Kexue huabao* 16 no.5, 1950, 238.
[526] Duzhe Xinxiang 讀者信箱 [Readers' Letters], *Kexue huabao* 16 no.7, 1950, 310.

is wrong. Only when we summon the courage to ask do we receive an explanation and increase our knowledge. Therefore, we welcome any question you may raise."[527]

The response to the unpublished letter shows that the scientific question itself was less important than the editor's opportunity to signal something to their new audiences: that readers need not have previous scientific knowledge or education, and that no question is too simple. The process of curating the Readers' Letters column was an attempt to present the kinds of audience and the type of community the editors aimed for. However, this attempt to produce a community ultimately failed, and the column gradually disappeared. One explanation for why the column shrank was that the kinds of readers the editors wanted to feature – workers, peasants, or soldiers asking basic and simple questions – simply did not write as much as more educated audiences did.

A new column, which first appeared in October 1950, was meant to facilitate a new way for readers to ask questions and participate in the journal. The column was titled "How, What, Why" (Zenme, shenme, wei shenme 怎麼，什麼，為什麼) and featured short questions about different phenomena. The first installment of this column contained questions such as "why is our breath visible in the winter?" and "why is it easy to balance while riding a bike, but hard to balance when the bike is not in motion?".[528] The answers would be provided in the following issue. The editors invited readers to send in similar questions, particularly "questions that have to do with things we encounter in daily life," and ensured reader that "the simpler the question, the better."[529] The first reader-submitted question appeared a few months later, in the issue published in February 1951. However, the editors published only the question and name of the reader, withholding any

[527] Duzhe Xinxiang, 310.
[528] Zenme, shenme, weishenme 怎麼什麼為什麼 [How, What, Why], *Kexue huabao* 16 no.7, 1950, 309.
[529] Zenme, shenme, weishenme, 309.

background information the reader may have included, and identifying markers such as age, place of residence, or occupation.

This column provided readers a way to take part in the publication, but it was qualitatively different from the Readers' Letters column. First, printing the readers' entire letter, rather than just the question, gave readers the ability to contextualize their queries, establish their credentials, and potentially make connections with other readers. The truncated, pointed questions of "How, What, Why" did not give any indication of the reader's identity. Making readers invisible to each other did not allow for the same sense of community and camaraderie that occurred in the Readers' Letters columns before 1950. Second, this kind of participation created a dynamic in which readers were treated as novices seeking the editor's expertise, rather than participating in creating scientific knowledge. Even though the journal's new goal was to better represent and incorporate "the masses", the result was alienating longtime readers and not providing enough space to build a community of new readers.

To the People, and Back

The swift change in audience was short lived. In October 1950, four months after the journal's new direction was announced, a note from the editors revealed that the transition did not go smoothly. Readers wrote in to express their dissatisfaction with the change in contents, style, and format.[530] The tone of the note indicated the editors were uncertain about their ability to reach workers, peasants, and soldiers. They wrote that the change had been an attempt, an initial exploration (*mosuo* 摸索), not a final decision. They were in the process of deliberating on the

[530] "Duzhe, bianzhe" 讀者編者 [Readers, Editors], *Kexue huabao* 16 no.7, 1950, 291.

next steps with their publisher, which at the time was still the China Science Society's Science Corp.[531]

The wavering and adjusting reflected the state of flux which characterized science popularization organs in the first years of the new regime. Although organizations such as the Science Dissemination Association were quickly established, they did not offer immediate and strict guidelines on how to carry out dissemination efforts. Nor were they able to resolve the tension that characterized science dissemination under socialism: the contradiction between top-down dissemination and the imperative to learn from the masses.[532] The question of the target audience for science was at the heart of this contradiction, and one way it was addressed was by allowing local branches of the association to determine their approach and their audience. The Shanghai Science Dissemination Association highlighted the unique conditions of the city in laying out their mission. As a major metropolis with many universities, they claimed they had favorable conditions for their work since the people of Shanghai had a higher education level, and more familiarity with science and technology. Therefore, their main audience were workers, as opposed to peasants.[533] Even though they had identified their audience, the association declared that during the initial stages, they will "wait to understand the (local) conditions and accumulate experience."[534]

Kexue huabao announced a return to its previous style and audience in March 1951, three months after the Shanghai Science Dissemination Association was officially established. In an

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[531] "Duzhe, bianzhe," 291.
[532] Schmalzer, *The People's Peking Man*, 135-136.
[533] Shanghai shi kexue jishu puji xiehui chouwei hui 上海市科學技術普及協會籌委會, "Fa kan ci" 發刊詞 [Opening remarks], *Shanghai Kepu*, 1 no.1, 1950, 12; Gao Xiaochong 高孝沖, "Tan Shanghai kepu xiehui ji qi ruhe kaizhan gongzuo de yijian" 談上海科普協會及其如何開展工作的意見 [Discussion of the Shanghai Science Dissemination Association and how to Develop its Work], *Shanghai Kepu* 1 no.3 (1951): 3.
[534] Shanghai shi, "Fa kan ci," 12.

editorial titled "The future of the magazine," *Kexue huabao* editors explained that the shift to target workers, peasants, and soldiers, was an attempt to address a deficit in science popularization publications for these groups. They reiterated that the change was an exploration rather than a definitive move. They announced that moving forward, the journal will "raise its level" and target more educated audiences, specifically commerce and industry workers; university, high-school, and professional school students; and peasants with middle school education.[535]

The timing of the statement and the fact that the magazine's editor and several of its writers were members of the Shanghai Science Dissemination Association indicate that the journal was taking cues from the newly established organization. What is striking in this example is that even as the journal became more intimately linked to government bodies, we do not see a dynamic of top-down instructions from a central party agency that determined the direction of the journal. The methods and audience for popular science were being adjusted and negotiated between publishers, editors, and members of government and party organs. At times these were the same people wearing different hats. The dynamic changes imply that there was flexibility in science dissemination even after it was brought under the auspices of the party-state.

It is also worth noting that the editors of *Kexue huabao* acknowledged the disappointment and dissatisfaction of long-time readers when the magazine started targeting different audiences, even though these readers were labeled petty bourgeoisie. Although reader's response alone may not have been sufficient to overturn the change in the magazine, it appears that it was at the minimum taken into account by the editors. The readers who felt alienated by the magazine's shift

[535] "Guanyu ben kan de fangxiang" 關於本刊的方向 [The Future of the Magazine], *Kexue huabao* 17 no.3, 1951, 107.

to target peasants and workers were those who purchased the journal or subscribed to it. This financial aspect was likely part of the decision to abandon the experiment of addressing the masses.

The focus on an audience with a minimum of middle school education continued throughout the 1950s. When the Shanghai Science Dissemination Association took over editing and publishing the journal, they stated that the journal would be suitable for those who had the equivalent of a grade nine education. In addition to students, this group also included industrial workers who attended night school, vocational school students, and some cadres and workers in factories.[536] Defining their audience this way was a return to the kinds of readers, and level of scientific content, that characterized the magazine from 1947. Despite the temporary attempt to aim the publication at readers with very rudimentary knowledge, the overarching trend was towards an educated audience rather than "the masses".

The National Science Dissemination Association took a similar approach when reviewing the Shanghai branch's 1952 work report. In their assessment, the national association instructed the Shanghai branch to raise the level of their work's content. Specifically, they found the lectures held by the branch to be "too simple and narrow," given the city's workers higher level of education.[537] The changes in *Kexue huabao* happened on a different timeline from the Shanghai Science Dissemination Association. Therefore, we cannot easily surmise that one precipitated the other. The magazine, at least until 1953, was not a subsidiary of any state organ, and was not under external pressure to change. Rather, the journal's editors and writers participated in shaping the

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[536] Jieban chuban tongsu kexue zazhi "Kexue huabao" jihua 接辦出版通俗科學雜誌"科學畫報"計劃 [Plan to Take Over Publication of the Popular Science Magazine "Kexue huabao"], November 1952, Shanghai Municipal Archives B34-1-51.

[537] Duiyu Shanghai fenhui chouweihui gongzuo zongjie he Shanghai fenhui 1952 nian gongzuo jihua dagang de yijian 對於上海分會籌委會工作總結和上海分會 1952 年工作計劃大綱的意見 [Response to the Shanghai Branch Preparatory Committee Work Summary and Plan for 1952], March 1952, Shanghai Municipal Archive C42-1-20.

policies that guided the official science popularization agencies in the early years of the People's Republic.

Reframing the World of Science

What happened to the journal's commitment to bring "the world of science" to its readers? Trans-national engagement continued to be an important framework for the magazine after 1949. However, the new political landscape engendered a more rigid approach to national boundaries. The vision of science as a universal form of knowledge that had the potential to transcend borders and political alliances was replaced by a division into good and bad science. It was still important to the editors of *Kexue huabao* to keep their readers informed about developments in science outside of China. But after 1949, there was a clear moral value attached to science from different countries. The United States in particular was portrayed as an example of using science in a negative way. Scientific research and technologies from the Soviet Union were, unsurprisingly, characterized as beneficial and positive.

The early policy of the Chinese Communist Party of "learning from the Soviet Union" was adopted in specific scientific disciplines, and in science education and dissemination.[538] Members of the Science Dissemination Association and its branches visited Moscow in October 1954 to learn from their counterpart, the Soviet Union Association for Disseminating Political and

[538] Zhipeng Gao demonstrates this through the example of how Pavlovian theory became orthodox for several disciplines in the early 1950s. Zhipeng Gao, "Pavlovianism in China: Politics and Differentiation across Scientific Disciplines in the Maoist Era," *History of Science* 53 no.1, (2015): 60-63; In the realm of science dissemination, Schamlzer shows the influence and wide utilization of texts produced in the Soviet Union on Chinese materials on evolution and human origins. Schamlzer, *The People's Peking Man*, 65-67.

Scientific Knowledge.[539] They visited museums, exhibitions, research institutions, and the editorial offices of two science magazines.[540]

When the Shanghai branch of the Science Dissemination Association took over editing and publishing *Kexue huabao* at the end of 1952, their editorial policies continued to reflect the importance of exposing readers to science in other countries. The editors included articles on scientific developments in the Soviet Union and other "brethren" states (*xiongdi guojia* 兄弟國家) as a way to promote internationalism (*guoji zhuyi* 國際主義).[541] In 1953 the magazine stopped being sold outside of China. But in 1956, the editorial committee successfully petitioned the Ministry of Culture, the Shanghai Education Bureau, and the national Science Dissemination Association to allow the magazine to sell copies in East Asia.[542] The idea that science was a trans-national endeavor was not discarded. But it had shifted geographically to accommodate new political alliances.

Good and Bad Science

The magazine continued publishing articles about foreign science, but now these took on a distinctly political nature, mirroring cold-war narratives. During the Second World War, the culpability of scientists in creating destructive weapons was a topic of debate in *Kexue huabao*. Most writers and editors held the position that politicians, and not scientists, were responsible for

[539] "Zhonghua quanguo kexue jishu puji xiehui fang su daibiaotuan gongzuo baogao" 中華全國科學技術普及協會訪蘇代表團工作報告 [Science Dissemination Association Visit to the Soviet Union Work Report], *Kexue tongbao* July 1955, 48-52.
[540] "Zhonghua quanguo," 48.
[541] Kexue puji xiehui 科學普及協會, Jieban chuban tongsu kexue zazhi kexue huabao jihua 接班出版通俗科學雜誌科學畫報計劃 [Plan to transfer popular science journal *Kexue huabao*], November 1952, Shanghai Municipal Archive B34-1-51.
[542] Kexue puji xiehui 科學普及協會, Wei Kexue huabao chuguo faxing shi zhengqiu yijian 为科学画报出国发行事征求意见 [Seeking Advice on the Matter of Publishing *Kexue huabao* Abroad], August 1956, Shanghai Municipal Archive A23-2-161-3.

the atrocities that newly developed weapons brought on civilians. This somewhat naïve view that divorced science from its political context was replaced with the opposite. After 1949, the role of imperialist ideologies and politics in scientific research was acknowledged, but in a rigid, black and white lens. Socialist science was good, capitalist science was evil; the Soviet Union was using science to benefit humanity, the United States was using science to destroy the world.

The United States, an ally to China during the Sino-Japanese war, was now an enemy. It was denigrated in the press as a symbol of the evils of capitalism. It became an actual military threat once China had entered the Korean war. Before 1949, the magazine relied heavily on images from British and American popular science publications such as *The World of Wonder*, *Popular Mechanics*, and *Popular Science*. But the Chinese Communist Party's declaration of alliance with the Soviet Union meant that the United States was no longer a diplomatic or cultural partner.[543] Cold war politics were reflected in *Kexue huabao* through the disappearance of images of American and British scientists and their research, the increasing number of articles about Soviet science, and the way American science was represented. One example of how politics framed scientific knowledge was in articles on the atomic bomb. This topic was particularly fraught because of the role nuclear energy and weapons played in fueling cold-war dynamics. Nuclear energy was portrayed in Chinese media as evil in the hands of "imperialists" such as the United States, but as a powerful technology that in the right hands could be used for benevolent purposes and turn deserts into flourishing agriculture lands.[544] After 1950, writers in *Kexue huabao* characterized the atomic bomb as a horrible weapon, in stark contrast to how it was previously discussed. In the immediate aftermath of the bombing of Hiroshima and Nagasaki in 1945 and up

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[543] Zhihua Shen and Yafeng Xia, *Mao and the Sino-Soviet Partnership, 1949-1959: A New History* (Lanham: Lexington Books, 2015), 33-35.
[544] Henrietta Harrison, "Popular Responses to the Atomic Bomb in China, 1945-1955," *Past and Present* supplement 8 (2013): 104-105.

until 1949, writers in the magazine described it as the pinnacle of scientific achievement and a "good" weapon that ended war and reduced the number of casualties.[545] But after 1950, even the argument that the atomic bomb had ended the war was contested.[546]

One example was an article that combined short, rhymed verses with prose paragraphs. The article was titled "Boo! Get Lost, Atomic Bomb!" (Pei! Yuanzidan qu ni de! 呸！原子彈去你的!). It described the horrors of this weapon as well as the principles of atomic fission.[547] The article combined narrative paragraphs describing the events that led to the bombing with short verses that accentuated particularly emotive parts. Author Mao Zuoben 茅左本 started with a verse decrying the atomic bomb as a "scoundrel" that brought devastating death. He then explained that the atomic bomb was not the deciding factor that ended the war. The Soviet Red Army had already defeated Hitler, and Japan was planning to surrender, but President Truman decided to drop atomic bombs on Japan because of his evil heart.[548] The atomic bomb was evidence of the cruelty of the imperialist United States government.

Most of the article focused on the political and historical context, and included criticism of the United States' experiments with the atomic bomb on islands in the Pacific. One part of the article explained fission. Mao used the metaphor of an army, to illustrate layers and components. An army has divisions, brigades, and regiments. Each regiment can be divided further, until reaching the smallest unit – the soldier. Breaking down into these components was akin to fission.

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[545] For example, Yang Jifan, "Zuihou shengli zai jinhou kexue jiaoyu shang de jiaoxun" 最後勝利在今後科學教育上的教訓 [Ultimate Victory is in Implementing the Lessons of Science Education], *Kexue huabao* 12 no. 1, 1945, 5.
[546] Historians have argued that contrary to the United States' position, Japanese surrender would have been possible without use of an atomic bomb. Robert J.C. Butow, *Japan's Decision to Surrender* (Stanford: Stanford University Press), 1954, 133. This was also a common interpretation in Chinese media immediately after Japan surrendered. Harrison, "Popular Responses to the Atomic Bomb," 103.
[547] Mao Zuoben 茅左本, "Pei! Yuanzidan qu ni de!" 呸！原子彈去你的 [Boo! Get lost, atomic bomb!], *Kexue huabao* 16 no.5, 1950, 219-223.
[548] Mao Zuoben, "Pei!," 219.

Mao also explained what gases were, by contrasting them with matter such as metals. Everyone knows what air is, he wrote, but air is comprised of different gases. Geared at an audience with low levels of literacy, perhaps soldiers, the text included homonyms to help readers pronounce the names of elements such as oxygen, hydrogen, and nitrogen.[549] The inclusion of verse, the use of metaphor, and the reading instructions were all new practices in the journal, an attempt to make complex scientific concepts and foreign terminology accessible to readers with low levels of literacy and little background in science.

Anti-American propaganda was not limited to articles on the atomic bomb. American science was villainized also because it benefitted capitalists and not the people; and it was in service of war. A *kuai ban* titled "America's Science of Warmongering and Violation" claimed that American science was exploitative, contributing only to enriching the bourgeoisie and not the people. The results of scientific progress in America, the author argued, were unemployment and death on the battlefield.[550] American citizens could choose between poverty or serving as cannon fodder in the Korean War.

The author did not just berate the United States' imperialist politics, but also criticized its scientific institutions. Freedom of research was extremely limited. Only two topics were on scientists' agendas, he wrote: expanding war and extracting oil. American universities were also described as corrupt and subservient to capitalists. Harvard was supported by the Morgan family, and the Rockefellers controlled the University of Chicago. The rhyme "A photography company established a university, and even the toothpaste boss is a proud owner of one," referred to Eastman Kodak Company donating funds to the University of Rochester, and to William Colgate of the

[549] Mao Zuoben, "Pei!" 220.
[550] Pan Jijiong 潘際坰, "Meiguo zhanfan qiangjian kexue" 美國戰販強姦科學 [America's Science of War Mongering and Violation], *Kexue huabao* 16 no. 7, 1950, 276.

Colgate company, who was a founding trustee of Colgate University.[551] The piece continued to describe the financial ties between American universities, the military, and private companies. All of this was evidence that America's science did not benefit the common people. Despite being written as a *kuai ban*, a form of verse meant to be performed orally, and therefore potentially addressed to peasants, it did not convey any useful or practical knowledge. It was important political knowledge, to be sure. But the many references to research institutes, companies, and universities, were geared towards the more educated readers, some of whom may have studied abroad, or who knew others that did.

Another article combined caricatures, narrative paragraphs, and couplets, to discuss science in the United States. The author, Liu Peiheng 劉佩衡 focused on how science was used to further the United States' military goals. One couplet read: "America's imperialist science wears a uniform, it is busy producing weapons and ammunition, pests, toxins, bacteria, and atomic bombs. It is in a manic frenzy to destroy peace."[552] America's science was not as great as it claimed to be, Liu wrote. For example, only a few Americans won the Noble prize, the greatest scientific achievement. Thomas Edison, who used to be considered by Chinese scientists a shining example of scientific research, was criticized by Liu for not really understanding Chemistry. This was especially ironic since before 1949, the China Science Society gave out an award named after Thomas Edison, and *Kexue huabao* had published several articles praising him.

Not all traces of "Western" science (i.e., Western-Europe and the United States) were excised from the journal. English and Latin were still used to gloss names of species and technical

551 Pan, "Meiguo zhanfan", 276.
552 Liu Peiheng 劉佩衡, "Meidi de kexue zenyang?" 美帝的科學怎樣？[How is Imperialist America's Science Doing?], *Kexue huabao* 16 no.9, 1950, 349.

terms. For example, one article on common cotton pests in different regions in China included the Latin binomial, name of the species' discoverer in Latin alphabet, and its different Chinese names.[553] Articles that were translated from Russian had glosses in Russian, English, or both. An article about automatic breaks for trains that was translated from Russian included glosses in English and Russian for technical terms, such as *qilun fadianji* 汽輪發電機 (turbo-generator, турбогенератор) *ganyingqi* 感應器 (inductor, индуктор), and *pinlu* 頻率 (frequency, частота).[554] Interestingly, some of the Russian terms were direct borrowings from English. One possible explanation for having the terms in three languages was that readers were not as familiar with Russian as they may have been with English, or at least Latin script. Another reason may have been convenience for printing – the magazine already had the printing infrastructure that supported printing multiple scripts. However, providing foreign language glosses was also a way to signal the cosmopolitan nature of the text and the journal.

Western scientists who were allied with communist or anti-fascist parties and political causes were sometimes featured. One example was Norman Bethune (1890-1939), a Canadian doctor and member of the Canadian Communist Party. Bethune went to China as a volunteer and headed the medical support for the Chinese Communist Eighth Route Army between 1937 and 1939. After his death from blood poisoning in the communist base area where he provided medical services, Bethune became a symbol for international cooperation. Mao Zedong wrote a short essay in which he praised Bethune's "internationalist spirit."[555] After the Chinese Communist Party

[553] "Mian chong fangzhi fa" 棉蟲防治法 [Exterminating Cotton Pests], *Kexue huabao* 16 no.4, 1950, 172-173.
[554] Yu Haocheng 俞皓城, trans. "Huoche zidong shacheqi" 火車自動煞車器 [Automatic Breaks for Trains], *Kexue huabao* 16 no. 9, 1950, 379.
[555] Mao Zedong, "In Memory of Norman Bethune," *Selected Works of Mao Tse-tung*, vol.2 (Beijing: Foreign Language Press, 1965), 337-338.

came to power, official state media would annually published articles in Bethune's memory. [556] The article in *Kexue huabao* briefly introduced the readers to Bethune, claiming he was a world-renowned doctor.[557] The article did not focus on Bethune's medical practice, or the organization of field medicine, but described his personality through anecdotes about his work ethic and uncompromising standards. The author did not disclose the source for the stories or quotes he used. Considering his symbolic position as emblem of the "international spirit", it is surprising that the magazine did not publish more than one article about the doctor.

Another example was a biography of Frederic Joliot-Curie (1900-1958), a French left-wing physicist who was the figurehead for the Stockholm Peace Appeal calling to restrict use of atomic bombs.[558] The author of the article used Joliot-Curie's story to make an argument about nuclear energy. The article included a short history of the research that led to discovering the atom, followed by an explanation of atomic fission. The author then wrote about Joliot-Curie's work, together with Irene Curie, on the chain of reactions in the atom. The author asked, how can a physicist who worked on the atom be the leader of an appeal to stop use of nuclear weapons? The answer was that the scientist's ideology, shaped by his encounters with fascism in Europe and by the imperialist aggression of the United States, convinced him that it should be banned. However, the author claimed that a distinction should be made between a negative use of nuclear energy for weapons, and its appropriate use for peaceful construction.[559] Authors in *Kexue huabao* were now

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[556] Lu Xiaoning, "In the Name of Internationalism: The Cinematic Memorialization of Norman Bethune in Socialist China," in Aga Skrodzka, Xiaoning Lu, and Katarzyna Marciniak, eds., *The Oxford Handbook of Communist Visual Cultures* (Cambridge: Oxford University Press, 2020), 342-344.

[557] Yifei 一飛, "Zhongguo renmin de zhanyou – Baiqiuen daifu" 中國人民的戰友 – 白求恩大夫 [A Comrade-in-Arms to the Chinese People – Doctor Bethune], *Kexue huabao* 15 no.12, 1949, 432.

[558] Writings by Joliot-Curie inspired other Chinese writers writing about atomic energy in the early 1950s. Harrison, "Popular Responses to the Atomic Bomb," 104.

[559] Chunbai 純白, "Yueli'ao Juli" 約里奧居里 [Joliot-Curie], *Kexue huabao* 16 no. 9, 1950, 355-357.

ready to acknowledge how ideology can shape a scientist's priorities, even if their research was still considered pure.

Sometimes when American or European scientists were mentioned, the focus was on their individual achievements and their global contributions, sidelining their national affiliation. An oil painting of Louis Pasteur, by Finnish painter Albert Edelfelt was featured on the cover of the issue published in December 1949.[560] An article about Pasteur in that issue, written by Liu Peiheng, described his achievements as a contribution to all of humankind, and focused on his research on the rabies vaccine.[561] The article opened with a colorful anecdote about Pasteur's first experimental use of the vaccine. A sick child from the countryside was brought to his hospital in Paris. Pasteur had harvested "venom" (*duzhi* 毒汁) from the spines and brains of rabid dogs, and had attenuated the virus by heating and cooling it. After considering the child's condition, he decided to inject him with the virus, a decision the author characterized as bold and risky. The result? The child got his life back, and "numerous victims of rabies around the world now had a saviour."[562] Liu did not hide Pasteur's French origin: he wrote about his childhood in Paris, the universities where he taught, and other French scientists he had worked with. But he also characterized him as a globally significant scientist: almost every country, China included, had a Pasteur research institute; the scientist was not only a beloved son of France, but a beloved son to the world.[563]

[560] The caption on the cover credited Edelfelt as the painter. Cover, *Kexue huabao* 15 no. 12, 1949.
[561] Liu Peiheng 劉佩衡, "Baside zhuan" 巴斯德傳 [Biography of Pasteur], *Kexue huabao* 15 no.12, 1949, 429-431. The same issue also carried a speech about rabies and the importance of inoculation given by Dr. Guo Chengzhou 郭成周, head of the Shanghai Pasteur Institute.
[562] Liu Peiheng, "Baside," 429.
[563] Liu Peiheng, "Baside," 431.

American scientists were a different case. An article on Rickettsia, a bacterial genus, included some background on the pathologist who discovered it in 1910 – Howard Taylor Rickett (1871-1910). Rickett discovered the bacteria while searching for the pathogen responsible for spotted fever. Unfortunately, he contracted the disease himself while doing research and died. The authors praised him as a "science warrior" who "gloriously sacrificed" his life.[564] A small headshot of Rickett appeared at the head of the article. However, nowhere was it mentioned that he was American. Foreign scientists who were not from communist aligned countries were rarely mentioned after 1949. Nevertheless, their occasional appearance indicated that the view of science as a global project persisted.

The onset of the cold war and the shifting alliances of the Chinese government did not mean that *Kexue huabao* had to erase parts of the scientific world. Rather, the journal found different strategies to represent a new world view, which maintained more rigid ideological boundaries. The strategies included vilifying the United States and its scientific institutions – but not individual scientists, and highlighting scientists who were ideologically aligned with the Communist bloc. Focusing on global contributions of scientists and minimizing their national identities was another strategy. Politics and ideology became much more important in the journal's reporting on scientific developments and research.

A New History of Science

The magazine's foreign content increasingly centered on Soviet science. Starting from the last issue of 1949, published in December, and until the end of 1952, each issue contained between two and five articles on Russian or Soviet science, taking up between six and ten pages of the 46-

[564] Cao Lusheng and Yang Sikun 曹鹿笙 楊嗣坤, "Renshi Likeci shi ti" 認識立克次氏體 [Understanding Rickettsia], *Kexue huabao* 18 no.6, 1952, 192.

page journal. In some cases even more space was dedicated to Soviet science, such as a special issue to celebrate the 35th anniversary of the October Revolution published in October 1952. "Learning from the Soviet Union" in the journal included three kinds of articles. The first kind, articles that were overtly political with little connection to science, was relatively rare. One such article was a short list titled "Glorious Communism in Numbers," which contained production statistics.[565] Another example of this type was an editorial titled "Forging ahead to a Communist Victory."[566] The second and much more common kind were articles that focused on new technologies from the Soviet Union and large-scale public projects such as dams. The third category included articles on the history of science in Russia and the Soviet Union, both before the October Revolution and after, incorporating it into a broader history of science. Introducing readers to "great Soviet scientists" and their achievements was one the editorial board's goals.[567] The magazine published biographies of important contemporary Soviet scientists, but also of significant figures in the history of Russian science. Articles with titles such as "Introducing Soviet Science" often referenced pre-Revolution developments in disciplines such as chemistry or physics and compared them with the equivalent Western European figures.

One example was an article by Cao Zhongyuan 曹仲淵 titled "Introducing Science in the Soviet Union." Cao opened by stating that there are many articles about Soviet science in newspapers and magazines.[568] This article, however, introduced a new perspective: that of science

[565] Wang Yongjia 王泳嘉, "Weida Gongchan zhuyi de shuzi" 偉大共產主義的數字 [Glorious Communism in Numbers], *Kexue huabao* 18 no.3, 1952, 82.
[566] "Xiang gongchan zhuyi shengli qianjin" 向共產主義勝利前進 [Forging ahead to a Communist Victory], *Kexue huabao* 18 no.8, 1952, 256.
[567] Kexue puji xiehui 科學普及協會, Jieban chuban tongsu kexue zazhi kexue huabao jihua 接班出版通俗科學雜誌科學畫報計劃 (Plan to Transfer Popular Science Journal *Kexue huabao*), November 1952, Shanghai Municipal Archive B34-1-51.
[568] Cao Zhongyuan 曹仲淵, "Sulian kexue jieshao" 蘇聯科學介紹 [Introducing Science in the Soviet Union], *Kexue huabao* 15 no. 12, 1949, 433.

before and after the October Revolution. Freedom of scientific thinking was a requirement for the development of natural science, Cao wrote. In the Tsarist period, there was no real freedom of thought, and therefore there were only a few exceptionally talented individuals who could surpass these conditions. Cao mentioned ten Russian figures who contributed to Chemistry, Mathematics, Aviation, and other fields. Ivan Polzunov (1728 – 1766) was credited with coming up with a design for a steam engine before James Watt, "the English man we assume invented if first."[569] Cao continued revealing historical inaccuracies to his readers. No one knows, he wrote, that ten years before the Wright brothers, a Russian mathematician, Nicholas Zhukovsky (*sic*) (Nikolai Zhukovsky 1847 – 1921), had proved the theoretical possibility of flight, and designed an airplane.[570]

Cao argued that because the Tsarist empire was secluded and had little interaction with "global academic circles" (*shijie xueshu jie* 世界學術界), many people did not generally know about these important figures.[571] The description of Tsarist Russia as closed off from the rest of Europe was not completely true, but it reflected the tropes of portraying the old regime as backwards and "un-scientific."[572] Placing Russian scientists in relation to British and American scientists served as a way of decentering the West as the central location of scientific progress. In that sense, the histories of pre-revolutionary Russia set the stage for the grand scientific achievements of the socialist regime.

[569] Cao "Sulian kexue," 433.
[570] Cao, "Sulian kexue," 433.
[571] Cao, "Sulian kexue," 433.
[572] G.A. Tokaty, "Soviet Rocket Technology," *Technology and Culture*, 4 no.4, (1963):515-517.

A more comprehensive history of science in Russia's 18th and 19th centuries was published in February and March of 1950. This time, it was translated from Russian by Liu Peiheng.[573] The original author was only identified by surname, and the source of the article was not mentioned. The two-part piece offered a slightly different interpretation of science in Tsarist Russia from the one in Cao Zhongyuan's 1949 article. Even before the October Revolution, the author of this history claimed, Russian science was on a par with scientific development in Western Europe. The article traced the history of the Soviet Academy of Science to the Russian Academy, established by Peter the Great in 1724. The author argued that the establishment of this institution centralized research in a way that benefitted the advancement of science. It was also unique in its principles of training and educating younger students, setting Russian science apart from the rest of Europe.[574] Pre-revolution scientific institutions and scientists, especially those who lived through or joined the revolution, were celebrated as the foundation for contemporary Soviet science.

Biographies of Russian scientists frequently appeared in the magazine. The authors often used sources from the Soviet press and other Russian publications for their articles, resulting in narratives that mirrored the ways these figures were commemorated in the Soviet Union. A biography of polymath Mikhail Lomonosov (1711 – 1765) by Cao Zhongyuan was printed in December 1949.[575] It is not clear what sources Cao used to compile the article, but the narrative and tone closely echoed the heroic and mythological story shaped by Russian academics who

[573] Liu Peiheng 劉佩衡, trans. "Sulian kexueyuan yu E'luosi kexueshi" 蘇聯科學院與俄羅斯科學史 [Soviet Science Academy and the History of Russian Science], *Kexue huabao* 16 no.2, 1950, 80-83. The second installment was published in issue 3, but the third installment was never published, because of the journal's hiatus.
[574] Liu, "Sulian kexueyuan," 80-81.
[575] Cao Zhongyuan, "Sulian kexue zhi zu: Luomonuosuofu zhuan" 蘇聯科學之祖羅莫諾索夫傳 [Founder of Soviet Science: a Biography of Lomonosov], *Kexue huabao* 15 no.12, 1949, 423-424.

presented him as the "father of science" in Russia.[576] Cao, like Russian historians of science, also credited him with establishing the first chemical laboratory in Russia, and making significant contributions to astronomy and metallurgy.[577]

Other "founding father" figures of Russian science were also introduced to readers. In 1950, an article by Liu Qingyi 劉慶儀 focused on Russian physiologist Ivan Mikhailovich Shechenov, (1830-1906), commemorating the 120th anniversary of his birth. Liu included a quote from Stalin, who praised the physiologist as one of Russia's great scientists and credited his research with forming the basis of natural sciences in the Soviet Union.[578] Liu's commemorative biography was based on articles printed in the August 1949 issues of *Soviet Woman* (*Sulian funü* 蘇聯婦女) and *Pravada* (*shihua* 實話, Truth. *Pravda* was the official newspaper of the Soviet Communist Party, established in 1912).[579] Other articles included a biography of Ivan Vladimirovich Michurin (1855 – 1935), a farmer whose work on heredity inspired Trofim Lysenko's theory of inheriting acquired characteristics.[580] A three-page long photo essay introduced 25 scientists in the Soviet Union, detailing their fields of research and significant accomplishments, accompanied by headshots.[581] These histories of science in Tsarist Russia and the Soviet Union were used as counter narratives

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576 Steven A. Usitalo, *The Invention of Mikhail Lomonosov: A Russian National Myth*, Boston: Academic Studies Press, 2013, 13. Usitalo examines Lomonosov's scientific work and argues that his position as "father of Russian science" had more to do with the narrative he and others fashioned around him, than actual scientific achievements.
577 Cao, 424.
578 Liu Qingyi 劉慶儀, "E'guo shengli xue zhi fu" 俄國生理學之父 [The Father of Russian Biology], *Kexue huabao* 16 no. 3, 1950,121.
579 Liu, "E'guo shengli," 122.
580 Lu Xinqiu 陸新球, "Miqiulin luxian zhizheng le yichuan yu yanhua" 米邱琳路線指正了遺傳與演化 [Michurin's Methodology Points to Mistakes in Heredity and Evolution], *Kexue huabao* 16 no.1, 1950, 21-23. Lysenkoism, which was known in China as Michurinism, was the politically acceptable interpretation of evolution and heredity until 1956. Laurence Schneider, "Learning from Russia: Lysenkoism and the Fate of Genetics in China, 1950-1986," in *Science and Technology in Post-Mao China*, eds. Denis Fred Simon and Merle Goldman (Cambridge, Massachusetts: Harvard University Press, 1989), 47.
581 Chen Wanghua 陳望華, "Jindai de Sulian kexue jia qunxiang" 近代的蘇聯科學家群象 [Group Photo of Contemporary Soviet Scientists], *Kexue huabao* 16 no.1, 1950, 17-19.

to the stories of scientific research and progress in Western Europe and the United States that were familiar to longtime readers of *Kexue huabao*.

Even though the magazine continued publishing articles that addressed science outside of China, there was a concerted attempt from the editors to increase domestic content. Having more articles about Chinese science was something the editors aspired to since the end of the Second World War. However, it was much easier and faster to translate articles and reprint images than to solicit original materials.[582] But after the establishment of the new regime, and particularly after the magazine announced its new direction in July 1950, focusing on local issues was a political imperative. The journal's editors criticized previous issues, particularly before 1949, for relying too much on foreign content, which made the entire publication detached from reality and not aligned with the people.[583]

These flaws were swiftly addressed starting in July 1950. Nearly all articles in the issue – 11 out of 12 – were about China.[584] Most of the issue contained articles on topics that were meant to be useful to farmers, and reflect the real problems of agriculture work. There were articles on different types of cotton plant pests and what insecticide to use; the uses and types of cotton; and a letter from the Agriculture Ministry expressing support for farmers. The only article about foreign science was on mechanical agriculture tools in the Soviet Union. Later issues published in 1950 similarly focused on topics that were directly related to China, with two to three articles about foreign science. The last issue of the volume, published in December 1950, reversed this: out of 11 articles, seven were about foreign science. Out of those seven articles, five were on new

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[582] "Zengjia women ziji de cailiao" 增加我們自己的材料 [Increasing our own Content], *Kexue huabao* 13 no.3, 1947, 128.
[583] "Women de ziwo jiantao" 我們的的自我檢討 [Our Self-Criticism], *Kexue huabao* 16 no.4, 1950: 185.
[584] This count represents only the articles, excluding columns.

technologies from the Soviet Union, one was a critique of imperialist science practiced by the United States, and one was about French scientist Frederic Joliot-Curie.

After the magazine "corrected course" in 1951 and returned to address more educated and urban readers, the journal generally featured an equal amount of foreign and domestic science. In most issues, half of the articles were either written by Chinese scientists or experts on their own research or were about topics that were specific to China, such as agriculture, geography, and animal biology. The other half was on foreign science and general topics without a specific geographic marker. For example, in February 1951, eight out of 16 articles were about science in China. The lead article was about a new machine that stamped the date on letters, written by its inventor, labor model Pu Rongchen 普榮琛.[585] Of the remaining eight articles, four were about Soviet science, and four about general topics or other foreign science, including an article about Nobel Prize laureates of 1950, and one about the chemistry of pigments.[586] Similar proportions of domestic and foreign articles continued throughout 1951 and in 1952.

Conclusion

The period between 1949 and 1952 was a time of change and re-organization for *Kexue huabao*. However, like other organizations that continued operating after the establishment of the People's Republic of China, changes were underscored by persisting continuities. Yang Xiaoshu, the journal's founder and editor-in-chief for almost two decades, resigned. However, the journal continued being published by the China Science Society until it was dissolved. Zhang Mengwen, the new head editor, and Lu Yudao, who served on the editorial committee, were both long time

[585] Pu Rongchen 普榮琛, "Duozhong ding'e youzi ji famingle" 多種定額郵資機發明了 [A Machine to Stamp Postage Has Been Invented], *Kexue huabao* 17 no.2, 1951, 42-43.

[586] Liu Peiheng, "1950 nian Nuobei'er kexue jiangjin" 1950 年諾貝爾科學獎金 [1950 Noble Prizes in Science], *Kexue huabao* 17 no.2, 1951, 60; Tang Ke 唐克, "Qiyi de bianhua – yanliao de gushi" 奇異的變化 – 顏料的故事 [Miraculous Transformation – the Story of Pigments], *Kexue huabao* 17 no.2, 1951, 57 – 60.

members of the China Science Society and contributors to *Kexue huabao*. They also held positions in newly established party organizations – the National Science Dissemination Association and its Shanghai branch. The editors of *Kexue huabao* were part of the process of re-conceptualizing science dissemination in socialist China. Although the magazine was nominally independent of these organizations until 1953, it was intimately linked to them. The changes in audience and content, therefore, should not be understood as strictly outside pressure to conform with new political imperatives. The journal's editors and writers were "insiders" who participated in charting the course for new science dissemination organizations. They may have felt pressure to conform to political discourse, and eventually the journal continued to address the kinds of readers it did before 1949. But the divide between the journal and official science popularization organs was blurry.

In some aspects of the magazine, we see longer lasting continuities. The short-lived change in audience, which in turn shifted the content, style, and tone of the journal, can be viewed as an aberration. After several months of trying to address an audience of "the masses", and particularly peasants, workers, and soldiers with low literacy and little background in science, the journal resumed the trend that began in 1947, and targeted readers with a foundation of science education. Only by examining the magazine on both "sides" of the 1949 does this longer trajectory become visible. However, after 1950 readers were given less space to participate in the journal. The Readers' Letters column was discontinued, replaced by "How, What, Why," a column that printed short questions on basic scientific concepts. While the editors claimed they wanted more input from readers, they provided less space for readers to demonstrate their knowledge and expertise.

The third aspect examined in this chapter, the trans-national view of science, further demonstrates the balance of continuity and change. Foreign science still existed in the magazine, whether through repudiation of evil American science or appreciation of Soviet technology. The writers and editors emphasized the history of science in pre-revolutionary Russian and in the Soviet Union, as a corrective to a Western centered history of science. The world of science was still being represented, but its geography had shifted. At the same time, the journal increased its domestic content. With more writers available, and more scientific research done in China to draw from (compared to the early 1930s), publishing articles on Chinese science, or science in China, was much more attainable. The shift to more Chinese science was not just an opportunity – it aligned with the political agenda of the magazine's editors. While the world was still an important category in thinking about science, it was no longer possible to portray science as borderless. It was increasingly defined by political alliances and national boundaries.

Conclusion

Kexue huabao's story did not end in 1949 as we have seen, but it also did not end in 1952. After it was transferred to the Shanghai Science and Technology Dissemination Association (Shanghai shi kexue jishu puji xiehui 上海市科學技術普及協會) it continued being published until 1966, was put on hiatus during the Cultural Revolution, and returned to print in 1972. It is still being published today by the Shanghai Science and Technology Publishers, and has an active WeChat account on which selected articles from the print edition are shared. The font of the magazine's title changed, and the English translation of its name has also changed to "Science Pictorial". The image on the cover of the October 2021 issue depicts a transparent human body with visible lungs and trachea. The transparent body is surrounded by floating, spiky balls (Figure 6.1). Almost any reader on earth at this moment would recognize the floating objects as SARS-CoV-2, the virus responsible for the COVID-19 pandemic, with its characteristic spike-protein. While many aspects of the magazine have changed, this dissertation argued that *Kexue huabao* is part of the reason that today, even non-scientists recognize an image of a virus, know what a spike protein is, and have at least a rudimentary understanding of what constitutes an immune system. *Kexue huabao* was part of the historic process that made science part of the daily lives of most citizens of world.

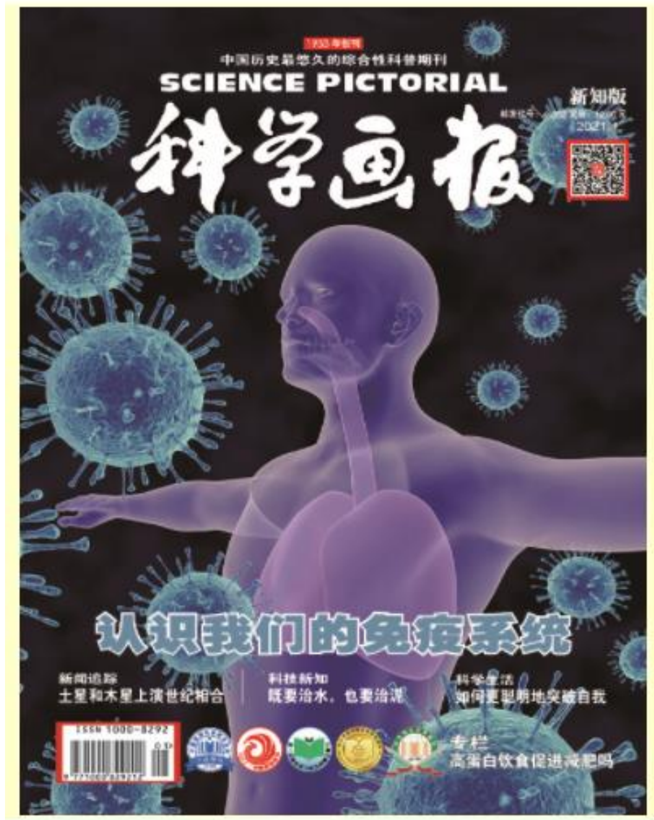

Figure 6.1: "Understanding our Immune System," *Kexue huabao* October 2021, cover.

<u>Everyday Science and Inconsequential Spaces</u>

A common narrative about science in 20th century China is that it was important, but mostly to intellectual elites. Histories of Chinese science have focused on the institutionalization of professional, modern science. This dissertation has endeavored to throw light on the flourishing arena of science popularization that existed side by side with the development of professional science in China. Science popularizers included powerful politicians and lower-level government workers, school teachers and college professors, publishers and commercial actors, and professional scientists. There was an audience keen on reading their publications and attending their exhibitions. The sphere of popular science, I have argued, is crucial in understanding how modern scientific knowledge became legible to people without advanced education.

Science popularizers in China defined and prescribed what constituted "common scientific knowledge." But this category was not neutral. The types of knowledge and narratives about science that they constructed were linked to their different political ideologies. In government projects, science was a tool in transforming people into citizens. As an abstract framework of knowledge, science lent an aura of modernity and validity to the kinds of knowledge government officials believed that citizens should have. Science exhibitions were meant to impart an understanding of the nation as a geo-political unit through maps, productions statistics, and natural history. Common knowledge was also gendered: science for women was primarily linked to their productive and reproductive roles. The government-led Movement to Scientize China presented science as a way to understand the nation. The movement intended to equip people with the kinds of knowledge they needed to be citizens.

In contrast, *Kexue huabao* presented a different narrative about what science was, and what kinds of knowledge their readers ought to possess. The publisher believed that readers in China needed to know about the newest scientific developments from around the world, and that people in Shanghai, Bangkok, Germany, and Washington, needed to have the same knowledge of science. Modeling the journal on the American *Popular Mechanics* and using articles and visuals from foreign publications was not simply a matter of copying. On the one hand, it was a convenient and efficient way to furnish the journal with copious and varied visuals. But it was also a deliberate statement about what scientizing meant to the publisher and editors. Readers of *Kexue huabao* were exposed to a visual vocabulary shared with readers of American, British, French, and Japanese magazines. Translating and editing pieces about scientific news and recent developments created a sense of a global reading community. Particularly during the Second World War, anxieties about new weapons were common themes for popular science journal in Europe, North

America, and Asia. The editors placed knowledge about China and knowledge about the world on equal footing. Common scientific knowledge in *Kexue huabao* was presented as transnational.

It is redundant to say that science was important to the China Science Society, the association that published *Kexue huabao,* but what deserves to be mentioned is that the journal was not only marketable but profitable, so much so that it was able to continue publication during the Sino-Japanese War and the civil war between the Nationalists and Communists. The continued publication of the journal after 1949 demonstrates that the Chinese Communist Party also saw great importance in "scientizing" the people. This was also the result of the influential positions that the magazine's editors and members of the China Science Society had in academic institutions and in state and Communist Party organs. But this also suggests an enduring interest in science from those outside academic circles, and an existence of a market for publications that presented modern scientific knowledge to non-specialists.

The idea of utility was also important in framing common scientific knowledge for popularizers across the political spectrum. Utility was meant to convince people that science was relevant to their lives, and not a complicated, opaque, highly specialized form of knowledge. The exhibition workers at the People's Education Centers aimed to construct displays that were relevant to ordinary people. But in practice, politics ended up taking precedence over utility. In the center's exhibitions, there was little in the way of practical advice for peasants or people who wanted to improve their manufacturing capabilities. Instead, there was "trivial" information that if people retained, would furnish an understanding of natural phenomena based on modern physics; and of topics such as agriculture, infrastructure, and geography based on political units. In these exhibitions, science was seen as a paradigm of knowledge that could replace "superstition," or supernatural beliefs about nature. It was therefore useful to the state.

In *Kexue huabao*, useful or applied science was contrasted with "basic" knowledge. Basic knowledge of science included the kinds of topics that were covered in Lu Shao Jingrong's series "Science Readings for Women and Children" (Furu kexue du wu 婦孺科學讀物) or in Lu Yudao's anatomy series. Common scientific knowledge provided readers with the building blocks for understanding their body and their immediate environment in terms of modern biology, anatomy, and physics, but it was not immediately applicable to daily concerns. Discussions on whether the journal should focus on applied or basic science entailed redefining the intended audience. Applied science was equated with technical knowledge that required previous knowledge of the principles of biology, chemistry, and physics, therefore implicitly catering to an audience with high-school education. After 1950, the idea of utility was tied to the lives of "the masses," the new audiences the journal wanted to attract. The articles shifted to focus on providing concrete information about hygiene, production, and agriculture, and used visuals that were meant to make this information tangible.

The readers of *Kexue huabao* occupied "inconsequential" spaces: they participated in science in their homes, in classrooms, and in their workplaces, through reading, writing, and coming up with inventions and solutions for the problems they encountered in their daily lives. Between 1947 and 1951, we see ample evidence that readers found the journal useful in their own endeavors, either in their work or as an intellectual pursuit and hobby. The expanded "Readers' Letters" column after World War II, columns such as "My Little Invention" and the reader's club brought to the surface the ways that readers were engaging with scientific knowledge at different levels. In these columns we see that readers were drawing plans and diagrams to improve the machines they worked with; they were reading books on plants and chemistry to decide what kind of pesticide to use; and they sought answers based on science to different problems in daily life.

Utility is not a neutral description, rather it is highly contingent on the intended and actual audience. What is useful can be different from what is usable; useful for one type of reader could be irrelevant to another. Examining the ways audiences of popular science make use of and take ownership over knowledge is a way to complicate how we think about useful, common, or basic scientific knowledge. Uncovering how these audiences thought about science demonstrates the appeal this body of knowledge had in Republican China.

Readers and Editors

One of the main questions of this project is: who were the readers of *Kexue huabao*? Using methodologies from the rich literature on periodicals and the burgeoning field analyzing scientific journals, I was able to start addressing this question. Objects and images played an important role in how science popularizers defined their audiences. In periodicals and in exhibitions, visual representations were supposed to reach viewers with lower literacy levels, such as women, children, and rural men. But these media were also seen as particularly relevant to science education. The concepts of science, popularizers believed, were better demonstrated in a visual manner.

In *Kexue huabao*, editorial decisions about the content, visuals, and communication with readers shaped the community that developed around the journal. The Readers' Letters column in the journal is an important space to observe the tension between the editors' agenda and the desires and expectations of readers. The editors of *Kexue huabao* had an intended audience which they tried to draw in. This intended audience shaped the content and images they chose, but also the letters from readers that they published, how they framed the letters – since the editors chose the titles for each letter they printed, and how they responded.

Editorial practices changed and evolved in the journal in response to the readership. In the first years of publication, the editors wanted the journal to appeal to women and children. Covers served an important role in drawing in readers. The cover of the first issue, featuring a boy and girl observing animals, vehicles, factories, and other elements of "science," can be seen as a statement of intended audience. Another way to attract these audience was to publish articles targeted at them. In *Kexue huabao*, writing for women encompassed mainly plant, animal, and human biology, topics seen as the basis of a scientific understanding of the world. Women in Republican China started participating in sciences beyond household science and home economics, and they may have been among the readers of the journal.

After the end of the Second Sino Japanese War in 1945, debates about how to best use science started anew in the government and among scientists. In *Kexue huabao* this was reflected in a reconsideration of the intended audience and an attempt to take stock of the actual readership. Although in principle the journal remained committed to printing basic scientific knowledge for those with no background in science, changing editorial practices gave more space to readers with some background in science. For one, there were more articles aimed at readers with higher levels of education. Expanding the Readers' Letters section to a space where readers could demonstrate their own knowledge, communicate with each other and with experts, and discuss their own scientific projects, made readers who were not complete novices more visible. The choices that the editors made defined the kind of reader that was visible in the magazine, and therefore the reader that is visible to historians analyzing the magazine.

At the same time, the readers existed whether they were given space in the journal or not. The journal gives us an opportunity to see these people and, to a certain extent, hear their voices. But it does not give us a definitive and comprehensive answer to who would be a reader of a popular science publication in Republican China. From the evidence available in the journal, and using other printed sources, we can compose a rough sketch of the typical reader. This group was composed mostly of men from urban centers. They were middle to upper class with at least a middle school education. They worked in white-collar jobs but also as managers in industrial settings. Many of the readers were students who wanted to become scientists, inventors, or engineers. Some readers were as young as 12. And some of them were not in mainland China: the journal had readers in the United States, Singapore, Indonesia, Macau, and Hong Kong. There were some outliers to this type, including women, workers in factories, and the occasional soldier. The readers who wrote letters to the journal asking questions, sharing their inventions, and seeking connections with other readers were motivated to do so because they were interested in science and thought that it could contribute to their lives.

Defining the audience was critical to how the editors of *Kexue huabao* delineated what counted as popular science. Catering to audiences of complete novices entailed "basic" scientific knowledge, specifically disciplines such as biology, natural history, and basic chemistry and physics. When the journal shifted to focus more on readers with some background in science, it featured more articles on mechanics, engineering, and technical knowledge. The intended audience, therefore, was an important consideration in what was included under the umbrella of popular science, demonstrating the interdependence of the relationship between the publisher and readers.

Universal Science in China

The relationship between China and science, defined by the notion of scientizing, was central to all science popularizer's projects. The Nationalist government viewed science through the framework of nation-building. In the government affiliated publication "Scientific China," scientizing meant demonstrating that modern science existed in China, and that science can be used to make China's heritage compatible with modernity. In the People's Education Centers, workers created displays that were meant to disseminate a body of knowledge that all citizens should have. A similar approach was taken by the Chinese Communist Party after 1949. Class politics did not preclude science from being an important part of the CCP's agenda. Disseminating scientific knowledge was an important way of improving living conditions and increasing production.

Reading *Kexue huabao* reveals a different approach to questions of science and nation. The publisher and editors portrayed science as universal, but also saw the importance of science for nation building. The view of science as a transnational endeavor was rooted in the experience of the group of scientists and educators who made *Kexue huabao*. As students in universities in the United States and Europe, they were trained in modern scientific disciplines, and participated in making scientific knowledge. The top scientists in this group were part of professional communities that were often transnational, and the ethos of science for the benefit of humankind was shared even by those who were not professional scientists. In turn, the editors of the journal wanted to include their readers in a global arena of scientific knowledge by exposing them to scientific news and developments from abroad.

The idea of science as universal served the journal in several ways. First, it was a way to market the journal as cosmopolitan, and to appeal to readers with exciting and varied visual content. Second, it allowed the writers and editors to contest the notion that modern science was uniquely Western. By framing science as a universal methodology, and highlighting the "scientific spirit" as the main component of doing science, the writers could carve a place for Chinese science and claim it to be as legitimate as science produced in the West. It also allowed them to take ownership over modern science, presenting cutting edge advances in science not as "belonging" to the countries they came from, but as a body of globally shared knowledge. The editors of *Kexue huabao* constructed their own view of universalism which displaced the West as arbiter of science but also necessitated an adaptation of Chinese language formatting.

Political circumstances such as the Second Sino-Japanese War and the establishment of the People's Republic of China in 1949 impacted the narrative of science as universal. During the war, the national politics of science were acknowledged in a much more straightforward way, in editorials on how people involved in science should contribute to the war efforts, and in drawing a line between good scientists and bad politicians and military leaders. During the war, another tension emerged in the journal – that of technology as potential menace. While texts in the journal argued that science could provide protection against harmful weapons, images accentuated the anxiety produced by these new weapons.

Images were also key in presenting a layered narrative of China's place in transnational science. The magazine's covers depicted universal, foreign, and local subjects, and mixed these divergent representations sometimes on one page. After 1949, the focus shifted to visuals that represented Chinese science and were meant to reflect the lives of "the masses." Foreign science was still featured, but it was now more overtly politicized. American science was depicted as evil, while Soviet science was represented as a model to be emulated.

Representing the "world of science" was possible for the editors of *Kexue huabao* because of their access to foreign publications. The publisher was influenced by American and British popular science magazines, and drew heavily from a wide variety of foreign sources for images and texts. The reliance on foreign sources, especially for images, limited the kinds of visual language the magazine could create. But through various practices of adapting, annotating, and editing, the journal took these sources and made them into something new. A close examination of some of the images and texts that were adapted from foreign sources reveals what "knowledge circulation" looked like in practice. By tracing the way visuals and articles were changed and adapted, this dissertation has argued that the editors of *Kexue huabao* were important actors in making modern science "universal" knowledge. Without their work, pieces of foreign magazines would not have ended in the hands of Chinese readers. Science popularizers in Republican China, therefore, have an important part in modern science becoming a global language.

What can *Kexue huabao* tell us about the broader history of science in modern China; and about the history of popular science and global science? Analyzing the journal demonstrates the extent to which science as category of knowledge penetrated the lives of "ordinary people" in Republican China. Using the journal as an archive, we can compose a rough portrait of the kinds of people who were interested in science: men in different middle-class vocations, school boys who saw science as a possible career, some women, and at least some factory workers and soldiers.

We also see that there were multiple ways to make science meaningful beyond connecting it with national salvation. Science popularizers across the political spectrum mobilized the idea of common, everyday knowledge, even if the promise of usable knowledge was not always fulfilled. To the readers of *Kexue haubao*, science was a pleasurable hobby and a way to think about problems in their work and life. This dissertation focused on one group of science popularizers. But there were different media through which scientific knowledge was broadcast to wider audiences, including books, radio broadcasts, and exhibitions; as well as other journals. The question of how science was presented to women in particular deserves more in-depth attention. Science was a critical part of constructing Chinese modernity, and science popularization projects offer an invaluable avenue through which to understand the cultural significance of science in China.

Kexue huabao also draws our attention to an emerging global *imaginaire* of popular science. The publisher and editors created a journal that blurred the boundaries of national and foreign. They believed that the Chinese reading public needed the same kinds of scientific knowledge as the English, French, or German reading public. By adapting visuals and texts from foreign publications, they created a cosmopolitan journal that invited readers to be part of an imagined global community. This cosmopolitanism was, however, one sided. Readers in the West were not exposed to the development of Chinese science in the same way. However, despite the fact that the circulation of knowledge did not happen on equal terms, there are some themes that emerge as concerns shared among readers across the globe. News of the development of different weapons and how to defend against them, as well as the process of developing the atomic bomb and using nuclear energy connected to the anxieties of readers worldwide during the interwar period and during World War II. Popular science, therefore, can be fruitfully integrated into global histories of science.

Histories of non-Western science have shown the important role of print in circulating modern science. But science promotors in Asia were more than nodes enabling a flow. The example of *Kexue huabao*, and other studies on modern science in colonial contexts, demonstrate that the international dissemination of texts and images was a much more active process, and a result of deliberate decisions and ideology. The challenges that Chinese scientists and science educators faced – engaging with foreign knowledge, being seen as latecomers to science, and attempting to construct national identities – were common across Asia. We see that science popularizers in China engaged the notion of science as universal as a way to contend with some of these questions. Constructing a universal science through texts and images allowed them to challenge the West’s superiority and to legitimize their own knowledge production as scientific.

When considering global histories of science, particularly in Asia, we may ask – how did scientists and educators think about science in relation to their place in the world? How did they mobilize the view of science as a shared human activity, belonging to all people? The publisher and editors of *Kexue huabao* selected texts and images from foreign publications to share with their readers, edited and adapted them to imbue them with new meanings, and utilized them to create their own vision of a universal science. Rather than being part of a circulation network, they were *circulators*. They therefore played a significant role in making modern science global.

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