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Talents First!: Wu Ta-you and Science Policy Infrastructures in the Republic of China (1927-1970)*

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In 1967, President Chiang Kai-shek (蔣介石, 1887-1975) appointed Dr. Wu Ta-you (吳大猷, 1907-2000) to head the Advisory Committee for Science Development (科學發展指導委員會) for the Kuomintang (KMT) government of the Republic of China (ROC). The KMT had gained control of Taiwan in 1945 and relocated governmental bodies to Taiwan in 1949 as the Chinese Communist Party gained control of the Mainland and established the People's Republic of China (PRC). Chiang's appointment of Wu made him the chief science advisor to the President, reporting directly to him through the new National Security Council (國家安全會議).[1] Three years earlier, a successful atomic bomb test on the Mainland had made security a paramount concern, with Chiang fearful that Taiwan could be wiped out in a single attack.[2] Then, one year earlier, the onset of a Cultural Revolution (1966-1976) on the Mainland had raised Chiang's hopes that clear instabilities there might bring opportunities for him to finally reclaim his lost territory. Advice and planning from the

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[1] Wu Ta-you 吳大猷, "The Development of Science in the U.S. and Recent Updates of Our Nation's Advisory Committee for Science Development (美國的科學發展—我國的科導會近態)," in Wu Ta-you ed., *Kexue yu kexue fazhan* 科學與科學發展 (Science and Science Development) (Taipei: Yuanliu Publishing, 1986 [1974]), 212-215.

[2] David Albright and Corey Gay, "Taiwan: Nuclear Nightmare Averted," *The Bulletin of the Atomic Scientists* 54:1 (1998), 54-60.

Security Council could help his government be ready.

For his part, Dr. Wu saw a different opportunity. He was excited that the Taiwan-based government was finally ready to build a systemic and coherent science policy that would not only properly support scientific research but also draw on scientists to inform national planning for defense, economics, and education through systematic, trans-departmental analyses.[3] To him, a systemic science policy had to begin with producing “talents” (人才), by which he meant researchers conducting fundamental science. However, a government still looking for ways to challenge and undermine the credibility of the Chinese Communist Party on the Mainland and reassert itself as the true government of China would take science policy in Taiwan in a much different direction.

A main theme in the history of science policy in Taiwan, and indeed across East Asia, has been the positioning of science infrastructures in nation building and rapid economic growth, with particular attention to high-tech industrial advancement.[4] J. Megan Greene, for example, champions the developmental state in Taiwan as an evolving convergence of institution building and leadership by technocrats, by which she means technically-trained state planners.[5] In the same vein, Alice Amsden and Chu Wan-wen find that government “upgrading policies” played key roles in helping Taiwan to support second-mover firms and achieve catch-up in high-tech industries,[6] and Wang Shi-chi details the government’s efforts to promote such new industries as watchmaking and electric cars and its turn to build the Hsinchu science-based industrial park.[7]

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[3] Wu Ta-you, “The Development of Science in the U.S.” (cit. n. 1), 212; Wu Ta-you, “Chiang Kai-shek and Science Development in Our Country: How I Became the Head of the Advisory Committee for Science Development (蔣公與我國科學發展：命我就科學發展指導委員會職的經過),” in Wu Ta-you ed., *Zai tai gongzuo huiyi* 在台工作回憶 (Memories of Works in Taiwan) (Taipei: Yuanliu Publishing, 1989 [1987]), 68-70.

[4] The term “infrastructure” helpfully leaves open questions of the relations among scientific and political institutions, scientific practices, science practitioners, etc. It does not distinguish the social from the technical in advance, holding that technical practices have social contents and vice-versa. See, for example, Susan Leigh Star and Karen Ruhleder, “Steps Towards an Ecology of Infrastructure: Complex Problems in Design and Access for Large-Scale Collaborative Systems,” paper presented at the Proceedings of the ACM Conference on Computer Supported Cooperative Work, Chapel Hill, North Carolina, 1994, 253-264; Susan Leigh Star, “The Ethnography of Infrastructure,” *American Behavioral Scientist* 43:3 (1999), 377-391; Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: MIT Press, 2010).

[5] J. Megan Greene, *The Origins of the Developmental State in Taiwan: Science Policy and the Quest for Modernization* (Cambridge, MA: Harvard University Press, 2008), 117-140.

[6] Alice H. Amsden and Chu Wan-wen, *Beyond Late Development: Taiwan’s Upgrading Policies* (Cambridge, MA: MIT Press, 2003).

[7] Wang Shih-chi 王仕琦, *Fuzi shuangjie, qinghua chuancheng: Xu Xianxiu yu Xu Xiasheng liangwei xiaozhang de gushi* 父子雙傑，清華傳承：徐賢修與徐遐生，兩位校長的故事 (A

On the other hand, an earlier labor study by G.S. Shieh challenges accounts that privilege state initiatives by calling for an analysis of production processes in small industrial firms.[8] And in an early review of the historiography of Taiwan's science development, Lin Chung-hsi and Fu Daiwie maintain that highlighting the work of technocrats and the success of government policy can inhibit critical attention to ways in which the KMT government used science policy to consolidate and legitimize political power.[9] Similarly, Chen Dung-sheng critically reviews the hegemony of the "latecomer thesis" of high-technology industry in Taiwan, calling attention to alternative approaches derived from studies of Chinese medicine and local reassembled-car technology that render visible multiple local trajectories and practical realities.[10] Finally, a recent study of a government-supported project to translate Joseph Needham's *Science and Civilisation in China* and fashion China /Taiwan as the sole legitimate heir of Chinese culture demonstrates the continued salience of struggles to position the infrastructures of science.[11]

In this article, we call attention to another evolving infrastructural initiative in science policy in Taiwan, one that emphasized the production of talents who could serve in government and lead through their knowledge of fundamental science. It stands out by highlighting the identities of scientists.[12] We trace the emergence of this initiative within the ROC through the career of Wu Ta-you, which culminated in the creation of the Advisory Committee for Science Development.

Wu's work has received relatively little critical attention. Greene's account includes a brief mention of Wu as one of the technocrats who helped to make Taiwan an international model for state-led development. He was "eager to construct a science development plan that would be overarching, forward looking, and actually

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Legend of Father and Son at National Tsing Hua University: Stories of President Hsu Hsien-Hsiu and Hsu Hsia-Sheng) (Hsinchu: Tsinghua University Press, 2001).

8 Shieh Gwo-Shyong, *"Boss" Island: The Subcontracting Network and Micro-Entrepreneurship in Taiwan's Developmen*t (New York: Peter Lang, 1992).

9 Lin Chung-hsi and Fu Daiwie, "Taiwan's Scientific Development in History: The Review of the Historiography of Taiwan's Scientific Development (歷史中的台灣科學－關於「台灣科學史」研究的回顧與檢討)," *New History* (新史學) 6:4 (1995), 165-199.

10 Chen Dung-sheng, "We Have Never Been Latecomers: A Critical Review of High-Tech Industry and Social Studies of Technology in Taiwan," *East Asian Science, Technology and Society* 9:4 (2015), 381-396.

11 Chu Pingyi, "Needham in Taiwan: Translating Science and Civilisation in China as Politics of Modernity and Identity," *East Asian Science, Technology and Society* 14:2 (2020), 379-392.

12 Scientists have interests and visions like any other social group. See, for example, John DiMoia's account of scientists in Korea using the government for part-time employment and income prior to the rise of what he calls the "scientist/bureaucrat" during the regime of Park Chung Hee. John DiMoia, "Atoms for Sale? Cold War Institution-Building and the South Korean Atomic Energy Project, 1945-1965," *Technology and Culture* 51:3 (2010), 615.

meaningful."[13] Yet, was it significant that Wu sharply distinguished researchers conducting fundamental science from the engineers and economists that constituted the bulk of the state planners Greene calls technocrats? Also, in an article offering a detailed institutional history of the Advisory Committee, Yang Tsui-hua highlights Wu's focus on scientific research. She portrays him as bringing to Taiwan an American model that advocated funding for the basic sciences to support future developments in the applied sciences. As we will see, Wu's career choices and movements between Taiwan and North America offer much evidence to support this view. Yet was it significant that Wu's advocacy for scientists as societal leaders extended beyond the view, common in the United States at the time, that government's main responsibility in science is to support and guarantee the freedom of scientific inquiry and autonomy of scientists?[14]

This article raises the possibility that Wu's career and life offer an example of the hybridity that can occur when a scientist gains meaning and purpose while moving through contrasting infrastructures of knowledge development. Wu Ta-you grew up on the Mainland, earned his Ph.D. in the United States, and advocated for scientists to serve the ROC as a nation. It suggests that, rather than contributing as an instrumental technocrat or proponent for autonomous basic research, he was adding the identity of the fundamental scientist to the established identity of the scholar-official, a longstanding pathway for talents in China.

Scientists on the Margins of Reconstruction

When the KMT first became powerful enough on the Mainland to officially announce a government, it had already approved what would become its "first affiliated government institution," a research academy.[15] In the months that followed, the Nanjing-based government would designate Academia Sinica (中央研究院) the "highest scientific research institution of the Republic of China" and affiliate it with the newly-created Grand Academic Council (大學院, a kind of ministry of education, to be governed by scholars).[16] It appointed Dr. Cai Yuanpei (蔡元培, 1868-1940), former president of the prestigious Peking University, as both director of Academia Sinica and chancellor of the Grand Academic Council. By the time Academia Sinica held its inaugural meeting the following year, it had four research institutes: Institute of Physics and Chemistry, Institute of Social Sciences, Institute of Geology, and a

[13] J. Megan Greene, *The Origins of the Developmental State in Taiwan* (cit. n. 5), 59.
[14] Cf. Vannevar Bush, *Science, the Endless Frontier: A Report to the President* (Washington: U.S. Govt. print. off., 1945), 9-10.
[15] Chen Shiwei, "Legitimizing the State: Politics and the Founding of Academia Sinica in 1927," *Papers on Chinese History* 6 (1997), 33.
[16] *Ibid*., 35.

Meteorological Observatory.

Establishing Academia Sinica fulfilled a long-held ambition by scientists in China to create an official national scientific organization. Many were members of the Science Society of China, a voluntary association founded in the United States in 1914 to advocate for science and promote the development of industry in China. One motivation was to be able to formally represent China at international scientific conferences. Without a national science organization, China had been excluded from the newly formed International Research Council, and Chinese scientists were unable to participate in the 1926 Pan-Pacific Science Congress in Tokyo.[17]

At the time, the Nationalist government appealed to senior literati and scholars as elder statesmen to add credibility to its split with the party's Wuhan faction and claim to be the government for all of China. As Chen Shiwei put it, Chiang Kai-shek and other KMT leaders were appropriating "traditional Chinese notions of the relationship between scholarship and the state …" The KMT treated them as literati with the expectation that these scholars would embrace a "typical pattern of behavior" that dated back to the late Qing period—"activism in the public realm and political participation"—and help build up modern science education and research.[18]

The literati had been the primary recruitment source for state officials until the late Qing dynasty. For the young elite men whose families could afford it, the moral and spiritual development of the self that was afforded by reading, reciting, and interpreting Confucian classics authorized them to take civil service exams and, if successful, gain bureaucratic positions as scholar-officials.[19] As Jerome Griedner put it, the scholar-official bore both the privileges and responsibilities of ethical leadership. They were to be:

> sincere, humane, and responsible men, obligated by reason of their superior endowments to protest against tyranny and speak on behalf of the people's welfare, though never themselves of the people. They were the voice of mankind's better nature, not the spokesmen of a popular cause.[20]

But scientists in China, by and large, wanted something different. Emphasizing that their knowledge and authority as scholars relied not on interpreting texts from the

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[17] Wang Zuoyue, "Saving China through Science: The Science Society of China, Scientific Nationalism, and Civil Society in Republican China," *Osiris* 17 (2002), 301, 318.

[18] Chen Shiwei, "Legitimizing the State" (cit. n. 15), 36, 23, 28, 32. The transformation and modernization of education was in general welcomed and spearheaded by the Chinese reformist literati. See, for example, Yeh Wen-Hsin, *The Alienated Academy: Culture and Politics in Republican China, 1919-1937* (Cambridge, MA: Harvard University Press, 1990), 89-92.

[19] Note that Confucius (551–479 BCE) did not necessarily prefer literary mastery to physical virtues. The use of Confucian classics in the civil examination as a privileged path to officialdom had its cultural, political and class dimensions. Grace Yen Shen, *Unearthing the Nation: Modern Geology and Nationalism in Republican China* (Chicago: University of Chicago Press, 2014), 64-65.

[20] Jerome B. Grieder, "Hu Shih: An Appreciation," *The China Quarterly* 12 (1962), 92-101.

past but on new research in the present, they wanted autonomy from governmental oversight. The Science Society of China, for example, explicitly sought to enable scientists to keep their distance from government. Its position was a "radical departure from the traditional Confucian view of scholarship in service to the government/state."[21]

The KMT largely agreed with the scientists. Rather than Academia Sinica, the main agency for utilizing science to inform decision-making became the National Reconstruction Commission (建設委員會). In 1920, the republican leader, Sun Yat-sen (孫逸仙, 1866-1925), had theorized the "reconstruction" of China to prevent it from becoming a "'dumping ground' for the … overproduction [of] commercial nations" following the end of World War I (1914-1918). China, he asserted, needed to "adopt . . . machinery" and "nationaliz[e] … production" to achieve genuine "unification."[22] In what became known as his "Industry Plan (實業計畫)", Sun outlined a massive program that sought guidance from science for constructing ports, railways, canals, and productive industries across China, as well as for expanding and sharpening its boundaries. Sun wanted, for example, cultivated land to be improved by "scientific methods" and "modern machinery." He wanted a "scientific bureau" to guide a massive expansion in the industrialized production of silk. "[S]cientific methods" would "improve the quality" and "increase the quantity" of the production of wool. And greatly expanded productive industries would depend upon extensive, country-wide infrastructures for transportation and communication. Sun's vision pictured China as recovering its position as the world's center of human progress, but only if national reconstruction was properly "based on knowledge, that is upon scientific planning."[23]

Quite explicitly in the "spirit" of Sun Yat-sen's plan, the National Reconstruction Commission was charged to "research, prepare, and complete a Reconstruction Plan for the whole country" starting with defense against the Japanese.[24] The commission's 39 members included all cabinet ministers, all heads of bureaus charged to

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[21] Wang, "Saving China through Science" (cit. n. 17), 310.

[22] Sun Yat-sen 孫逸仙, *The International Development of China* (Shanghai: Commercial Press, 1920), ii. Note that "reconstruction" meant to build, construct, or develop rather than to recover from war or return to a glorious past. William C. Kirby, "Engineers and the State in Modern China," in William P. Alford et al. ed., *Prospects for the Professions in China* (New York: Routledge, 2011), 285.

[23] *Ibid*., 138, 144, 145, 147.

[24] Wang Shu-Hwai 王樹槐, "Jianshe weiyuanhui dui zhongguo dianqi shiye de guihua 建設委員會對中國電氣事業的規劃 (The Reconstruction Commission's Plans for China's Electricity Industry)," in Kao Chun-Shu 高純淑ed., *Guofu jiandang geming yibai zhounian xueshu taolun ji* 國父建黨革命一百周年學術討論集 (Proceedings of Centennial Symposium on Sun Yat-sen's Founding of the Kuomintang for Revolution) (Taipei: Modern China Publishing, 1995), cited in William C. Kirby, "Engineering China: Birth of the Developmental State, 1928-1937," in Yeh Wen-hsin ed., *Becoming Chinese: Passages to Modernity and Beyond* (Berkeley: University of California Press, 2000), 141.

lead reconstruction in the provinces, and the mayors of the two major cities, Shanghai and Nanjing. The Commission established and managed large public companies, reaching a total of 130 companies by 1945. It worked to maximize cooperative initiative in private enterprise by building a huge regulatory apparatus.[25]

In Chiang Kai-shek's framing, the "development of education" was a "fundamental task" in national reconstruction, alongside military affairs and economic development.[26] With an eye toward the United States, Chiang championed "vocational education" at the secondary level to produce local personnel needed for Sun's plan.[27] That is, secondary students would gain introductions to science and then learn approaches to implementing it within the practices of work. In 1932, the Nationalist government introduced new regulations to build robust infrastructures of learning at the primary and secondary levels for productive work. They required that, by 1937, the budget for vocational schools must not be lower than 35% of the total budget for secondary schools.[28]

Parsing levels of science learning to emphasize production had the effect of privileging educational formation in engineering. A degree in engineering became a supreme achievement in science, clearly orienting learners toward industrial production as an end to benefit all. During the 1930s, existing programs in civil and mechanical engineering at Jiaotong, National Central, Tsinghua and other universities expanded greatly and were complemented by new programs in chemical and electrical engineering. Engineering enrollment doubled as the numbers of students in the arts fell by one-third and those in law and political science fell by one-half.[29] Many graduates went to work for the National Resources Commission, which grew to become a massive industrial bureaucracy. By the mid-1940s, it employed 64,000 officials, owned more than 65% of the industrial capital and controlled fully 40% of the country's industry.[30]

Physicists and other scientists found themselves on the margins of reconstruction.

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[25] Along the way, the government narrowed its charge to resources and its name to the National Resources Commission (資源委員會).

[26] Chiang Kai-shek and Philip J. Jaffe, *China's Destiny & Chinese Economic Theory* (New York: Roy Publishers, 1947), 160.

[27] *Ibid*., 176-177. For more on industrial vocational education in Taiwan, see Chen Shun Ching 陳順清, "The Industrial Education in Taiwan During 1927-1956: Taking Tainan Industrial Specialty School and Taiwan Provincial College of Engineering as Examples (1927-1956之台灣工業教育—以台南工業專門學校與台灣省立工學院為例)," Master's Thesis, National Tsing Hua University, 2007; An Hou-Wei 安後暐, *Meiyuan yu Taiwan de zhiye jiaoyu (1950-1965)* 美援與臺灣的職業教育(1950-1965) (USAID and Vocational Education in Taiwan, 1950-1965) (Taipei: Academia Historica 國史館, 2010).

[28] The Ministry of Education 教育部, *Di er ci zhongguo jiaoyu nianjian* 第二次中國教育年鑑 (The Second Almanac of Education in China [1934-1947]) (Shanghai: Commercial Press, 1948), 1023-1024.

[29] Kirby, "Engineering China" (cit. n. 24), 147.

[30] Kirby, "Engineers and the State in Modern China" (cit. n. 22), 295-297.

In 1938, Peking University, Tsinghua University, and Nankai University joined together in a wartime alliance. To escape the Japanese invasion, they formed the National Southwest Associated University (國立西南聯合大學) in Yunnan Province. There they conducted research and teaching as usual. Although establishing a central research academy had successfully elevated the new talents to the status of elite scholars, the KMT government did not immediately make scientists officials in a government committed to reconstruction.[31]

A Scientist to Serve?

When the Nationalist government formed in 1927, Wu was an undergraduate student in physics at Nankai University. Having entered in mining engineering, he had transferred to physics when the engineering department lost its funding and disbanded.[32] In the physics department, Dr. Rao Yutai (饒毓泰, 1891-1968) took him under his wing, encouraging him to pursue graduate study. Rao was one of the first Chinese physicists trained in the United States, having received graduate training at Harvard, Yale, and Princeton. His dissertation on the behavior of electrical arcs had been supervised by Karl Taylor Compton. When Wu was initially unsuccessful in obtaining a fellowship to study abroad, he went to teach part-time at Nankai. He taught Modern Physics and Advanced Mechanics there for three years.[33] At Nankai University, he became interested in becoming a scientist, and he learned it was crucial to study abroad if he wanted to become a physicist.[34]

In a 1978 interview, Wu explained his early interest in becoming a scientist by linking it to the status of classical literati. “By tradition,” he said, “the highest ideal of many of us is to become a scholar.” “Knowledge (學問) and academic learning (學術) were held in high esteem,” but only a few could afford advanced studies and

[31] Not until the revised edition of *China’s Destiny* did Chiang add that “beside the training of industrial personnel, the schools must also emphasize natural sciences to provide the basis for applied science,” Chiang Kai-shek et al., *China’s Destiny* (cit. n. 26), 180.

[32] Wu’s father died when Wu was 4 or 5 years old, the only son to the family. In an interview, Wu recalled that he chose mining engineering, the only engineering field at Nankai University, because his family was poor and he wanted to learn something practical to take care of his family. Laurence Schneider and Yang Tsui-Hua 楊翠華, “My Memories and Experience about Pursuing Science: An Interview with Wu Ta-you (我的科學心路歷程：吳大猷先生訪問紀錄),” in Wu Ta-you ed., *Wo de yisheng: xue, yan, jiao, jianyan* 我的一生：學、研、教、建言 (My Lifetime: Study, Research, Education, and Advice) (Taipei: Yuanliu Publishing, 1992 [1978]), 89.

[33] Hsu Jong-Ping, “The Scientific Research and Teaching of Ta-You Wu,” in Hsu Jong-Ping and Hsu Leonardo ed., *JingShin Theoretical Physics Symposium in Honor of Professor Ta-you Wu* (Singapore: World Scientific Publishing Company, 1998), 3; Wu Ta-you, “A Chronicle of My Life at Eighty-Five (吳大猷八十五自訂年表),” in *Wo de yisheng* (cit. n. 32), 344-345.

[34] Laurence Schneider et al., “My Memories and Experience about Pursuing Science” (cit. n. 32), 89.

"extremely few" could become talents. Since most people in China did not understand what science does, they respected scientists "in the same way educated intellectuals in general are respected." Wu did not say bluntly that he pursued science in order to achieve high status, but he was clearly aware that seeking a Ph.D. in the sciences would put him in the company of other educated intellectuals.[35]

With Rao's help, Wu was able to win a prestigious Boxer Fellowship from the China Foundation for the Promotion of Education and Culture to attend graduate school in physics at the University of Michigan. The fellowship's name alluded to the Foundation's role in "returning" the remaining balance of the indemnity for the Boxer Rebellion (1899-1901) that the Chinese government still had to pay, channeling the outstanding payments into funding education for the Chinese people. Funds from the China Foundation were to provide the institutions and tools necessary for modern science education and research.[36] Wu studied under Samuel A. Goudsmit (1902-1978), who gave him considerable freedom to pursue his interests. At a school with prominent research on infrared molecular spectra, he settled on investigating heavy elements, including what would be known as transuranics. Admitted in 1931 and with strong skills in English, he completed his Ph.D. in two years. Wu also later described how he had observed and come to respect the work of the department chair, Harrison Randall (1870-1969).[37]

The next year proved to offer Wu something of a light bulb. Choosing to stay in the United States for postdoctoral work appears to have made his Chinese identity more salient. He reported that he found it "hard to stay in the U.S."[38] While he did not offer specifics about a disconnect or sense of alienation, the Chinese Exclusion Act was still in force in the United States, not to be repealed until 1943. He did explain more generally that China still confronted challenges and humiliations from foreign countries during the 1920s and 1930s, including from Japan and the Western countries. And he was quite clear about the effect that the difficulty had on him and, he claimed, many others. He said, "[It] made us want to serve our country."[39]

At the time, that country was Nationalist China on the Mainland. He returned. His advanced education in the United States made it easy for him to find a university-level position, and he joined Peking University in 1934. In 1938, Wu retreated with Rao and other colleagues to Yunnan Province. Now a full-fledged researcher in theoretical physics, specializing in atomic structure, he published the first of his 21

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[35] *Ibid*., 84-85.

[36] Laurence A. Schneider, "The Rockefeller Foundation, the China Foundation, and the Development of Modern Science in China," *Social Science & Medicine* 16:12 (1982), 1219.

[37] Wu Ta-you, "From University of Michigan to Peking University (從密大到北大)," in *Wo de yisheng* (cit. n. 32) (1992 [1991]), 270. We can only speculate that he might have found the work of leading a department to be interesting or provocative.

[38] Wu Ta-you, "Eighty Years of Experiences (八十經驗)," in *Wo de yisheng* (cit. n. 32) (1992 [1991]), 303.

[39] *Ibid*., 303.

books under the title *Vibrational Spectra and Structure of Polyatomic Molecules*.[40] It won the 1939 Ting Memorial Prize of Academia Sinica, which had maintained its independence through this period.[41] During the war with Japan, Wu achieved the status of a distinguished scholar, yet one who also had a desire to serve.

No Bomb without Talents

The atomic bomb changed the meaning of reconstruction and marked Wu Ta-you's first move into government service. In November 1945, about three months after the Americans devastated Hiroshima and Nagasaki with two bombs, the Military Administration Department (軍政部) of the Nationalist Government asked three professors of science from the allied universities to meet its minister. The minister expressed interest in establishing an "institute of scientific work for defense" that could eventually build an atomic bomb for China.[42] Wu was the only physicist in the group, which also included a chemist and a mathematician.

Wu agreed to participate in the project and immediately signaled an approach to science policy-making that prioritized long-term strategies. He argued that the first step should be to bring together in the institute all the disciplines that would be needed to build a bomb. However, China simply did not have the talents necessary. Wu asserted that "our nation has no foundation of science at all, not to mention [developing] advanced military technology [through science]." The only way to start, he said, was "by cultivating talents."[43]

To build the foundation of science, Wu suggested that the department first send people to the United States to investigate developments across a range of sciences in order to better "form concrete proposals" for founding a research institute, as well

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[40] Hsu Jong-Ping, "The Scientific Research and Teaching of Ta-you Wu" (cit. n. 33), 4, 6.

[41] Zhou Guangzhao, "Paragon of Scholars and Great Master of Physics," in *JingShin Theoretical Physics Symposium in Honor of Professor Ta-You Wu* (cit. n. 33), 36.

[42] Shen Chun-shan 沈君山, "The Philosoper Passed Away, His Paradigm Lives Forever: Remembering Mr. Wu Ta-you (哲人雖萎典範永存：追念吳大猷先生)," in The Physical Society of Taiwan ed., *Dianfan yongcun: Wu Dayou xiansheng jinian wenji* 典範永存：吳大猷先生紀念文集 (Forever Paragon: A Memorial Collection of Works about Mr. Wu Ta-you) (Taipei: Yuanliu Publishing, 2001), 96; Chou Hong-Yi 丘宏義, *Wu Dayou: Zhongguo wulixue zhi fu* 吳大猷：中國物理學之父 (Wu Ta-you: Father of China's Physics) (Taipei: Triumph Publishing, 2001), 642-643; Wu Ta-you, *Huiyi* 回憶 (Memories) (Taipei: Linking Publishing, 1977), 55.

[43] Wu Ta-you, "Hua Luogeng was Selected and Appointed by the Military Administration Department to Do Research in the U.S. (華羅庚係軍政部選派赴美研究)," *Biographical Literature* (傳記文學) 47:3 (1985), cited in Yang Tsui-Hua, "Planning Science and Technology in Taiwan: Wu Ta-you and the Commission for Science Development (臺灣科技政策的先導：吳大猷與科導會)," *Taiwan Historical Research* (臺灣史研究) 10:2 (2003), 70.

as to send "brilliant youths" to promptly study such fundamental sciences as "physics and mathematics." The long-term plan was to make the research institute a comprehensive infrastructure for "cultivat[ing] talents for all basic tasks."[44] Chen Cheng (陳誠, 1897-1965), then head of the Military Administration Department, approved Wu's proposal. He enlisted the three professors to investigate the status of weapons-related scientific research in U.S. universities, and they selected five students to pursue graduate study in the three fields they represented. Two of the five student members, Lee Tsung-Dao (李政道, 1926-) and Zhu Guangya (朱光亞, 1924-2011) had been students of Wu.

The plan for the study group was to stay in the United States for two or three years, as necessary, beginning in 1946. During that summer, Lee joined another former student of Wu, Yang Chen-Ning (楊振寧, 1922-), at the University of Chicago, where he became a student of Enrico Fermi (1901-1954), Nobel laureate in physics. Zhu gained admission to Wu's alma mater, the University of Michigan.

Wu himself obtained a temporary teaching position at the University of Michigan, to be followed by positions at Columbia University and New York University. During the next three years, while civil war raged on the Mainland, he regularly sent confidential reports back to the Military Administration Department.[45]

The costs of the civil war dried up funds for the study group, and then the ROC's relocation to Taiwan in 1949 forced its members to make difficult decisions with profound implications for their identities as scientists. Zhu Guangya chose to return to the Mainland, where he undertook research for the PRC on nuclear reactor development and helped lead atomic bomb and hydrogen bomb programs. Lee Tsung-Dao opted to continue his fundamental research outside of government in the United States, where he and Yang Chen-Ning would share the 1957 Nobel Prize in physics.

Wu Ta-you's case is especially provocative, lacking enough evidence to distinguish clearly among contrasting, and perhaps complementary, interpretations. He also did not return to China, nor did he join the displaced KMT government on Taiwan. Rather, he accepted an opportunity to become a researcher-administrator for the Canadian National Research Council in Ottawa. The Council wanted to expand its work in theoretical physics but could find no Canadians to join. At 41 years of age, Wu already had twenty publications on molecular spectra, twelve on atomic structure and spectra, and six on astrophysical problems under his belt. The Council voted quickly to appoint him as Associate Research Officer. A year later, promoted to Senior Research Officer, he was appointed to head the new Theoretical Physics

[44] Wu Ta-you, *Hui Yi* (cit. n. 42), 55.

[45] Wu Ta-you, "Acadimia Sinica and I (我與中央研究院)," in *Wo de yisheng* (cit. n. 32) (1992 [1980]), 127; Wu Ta-you, "A Chronicle of My Life At Eighty-Five" (cit. n. 33), 349; Wu Ta-you, *Zaoqi zhongguo wuli fazhan de huiyi* 早期中國物理發展的回憶 (Memories about Early Developments of Physics in China) (Taipei: Linking Publishing, 2001), 9-10.

section.[46]

According to one interviewer, Wu decided to stay in North America because of the civil war and the massive uncertainties facing the relocated KMT government.[47] At the same time, a biographer points out a serious personal issue that raises questions about Wu's return to the United States in 1946. His wife had traveled with him to the United States in 1931 but had encountered a serious health issue and chose to stay there in 1934 rather than return to China with him.[48] Perhaps staying in North America had become a marital commitment. Indeed, a year later they adopted a two-year old boy.[49] Perhaps Wu wanted to build his professional career around his personal commitments.

At the same time, Wu clearly threw himself into the work of cultivating talents while also continuing his own research. His administrative work included a significant amount of advising, recruiting, and supervising postdoctoral research fellows, organizing seminars and discussions, and building the scientific staff.[50] The research work won him a year at the Institute for Advanced Study in Princeton and included co-authoring a book on the quantum theory of scattering. The editor of a 1998 festschrift for Wu asserted that he was "comfortable both spiritually and materially" in Ottawa, where he stayed until 1963.[51] Whatever else it meant, it also indicated that Wu found a measure of fulfillment in serving as a fundamental science researcher working in a government position.[52]

Efforts to Build Policy around Cultivating Talents

In November 1956, Wu returned to the Republic of China for six-month visiting positions at the physics department at National Taiwan University and the nuclear research institute from National Tsing Hua University. Citing the post-war (re)construction of Taiwan, he found "many things are waiting to be revived" in science, with significant shortages in "education, academic research, talents, and equipment."

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[46] W. E. K. Middleton, *Physics at the National Research Council of Canada, 1929-1952* (Waterloo: Wilfrid Laurier University Press, 1979), 185-186.

[47] Lo Jen-Ling 羅任玲, "Love of a Lifetime Between Wu Ta-you and Juan Kuan-Shih (吳大猷與阮冠世的一世情緣)," in *Wo de yisheng* (cit. n. 32) (1992 [1990]), 213.

[48] Ibid., 206; Lai Shu-Ming 賴樹明, *Zhen yan: Wu Dayou zhuan* 真言：吳大猷傳 (True Words: Biography of Wu Ta-you) (Taipei: Mu mian, 1999), 35-36.

[49] Lo Jen-Ling, "Love of a Lifetime" (cit. n. 47), 213.

[50] W.E.K. Middleton, *Physics at the National Research Council of Canada*, 1929-1952 (cit. n. 46), 185-186.

[51] Hsu Jong-Ping, "The Scientific Research and Teaching of Ta-you Wu" (cit. n. 33), 10.

[52] We have not yet located archives, personal records, or secondary literature that would offer specific insight into Wu's initiatives cultivating talents via the Canadian National Research Council.

Since the vast majority of Chinese scientists had stayed on the Mainland, Wu assessed that the island had only two or three Ph.D.'s in physics or mathematics.[53]

As Wu understood the situation at the time, Japanese suppression of education during the colonial period (1895-1945) had produced a shortage of science talents. Most Taiwanese boys and girls were limited to elementary-level schooling. Even the sons of Taiwanese gentry could seek higher education only in medicine and engineering in colonial Taiwan or by funding travel to the Japanese mainland. Academic levels were still very low, in Wu's estimation.[54] Research was almost nonexistent, except in medicine, where there was "some groundwork."[55] Active research was being carried out by Ph.D.'s in engineering, but Wu did not judge such research as worthy of the status of fundamental science.[56] That view had been reinforced by his years helping to build fundamental physics research in Canada. In short, Wu, concluded, "we need to start from scratch."[57]

Toward the end of his visit, in April 1957, Academia Sinica put together its second Academicians meeting in Taipei, evidently with Wu in a prominent role. The first meeting had been held in Nanjing in 1948, in the midst of the civil war. Wu had been elected to the academy as one of 81 new members, but he neither knew who nominated him nor received any official notification.[58] The second meeting convened with only nine members, two of whom traveled from abroad to attend.[59]

Wu was well-prepared for the meeting. He made his move in two directions at the same time. On April 2, he put forward a proposal to ask the ROC government to develop a long-term plan for developing fundamental research in science. His fellow Academicians agreed and the motion passed. That same day, the *Central Daily News*,

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[53] Wu Ta-you, "Acadimia Sinica and I" (cit. n. 45), 129.

[54] Wu Ta-you, "University Entry Exam and Paths for Our Country's Science Development (聯考制度與我國學術發展的方向)," in Wu Ta-you ed., *Bashi shuhuai* 八十述懷 (Expressing My Thoughts at Eighty) (Taipei: Yuanliu Publishing, 1987), 221.

[55] Wu Ta-you, "Interview on Academic Research (談學術研究)", in *Zai tai gongzuo huiyi* (cit. n. 3) (1989 [1987]), 115.

[56] For example, at the time of Wu's stay, then Taiwan Provincial Cheng Kung University (later National Cheng Kung University) had at least four professors with Ph.D. degrees in its Department of Chemical Engineering. The department also had its own periodical. Through the venue, the faculty had communicated research results and new developments in the field since 1954. Weng Hong-Shan 翁鴻山, ed., *Huagong suyuan: guoli chenggong daxue huaxue gongcheng xuexi xishi* 化工溯源：國立成功大學化學工程學系系史 (The History of Chemical Engineering at National Cheng Kung University) (Tainan: The Foundation of Chemical Engineering at Cheng Kung University, 2013), 100-101, 388-394.

[57] Laurence Schneider et al., "My Memories and Experience about Pursuing Science" (cit. n. 32), 110.

[58] Tao Ying-hui 陶英惠, *Dianxing zai suxi: Zhuihuai zhongyang yanjiuyuan liuwei yigu yuanchang (shang)* 典型在夙昔：追懷中央研究院六位已故院長 (上) (Remembering Six Late Presidents of Academia Sinica, Vol. 1) (Taipei: Sow We Publishing, 2007), 119.

[59] Among its 81 academicians, only nine retreated with the KMT regime from China to Taiwan after 1949. Ibid., 156-158; Wu Ta-you, "Acadimia Sinica and I" (cit. n. 45), 129.

the state-run newspaper, published his vision and plan for national science development in an essay titled "How to Develop Our Country's Science."[60]

He tied his argument to the KMT's hope to retake the Mainland. "For our great plan to reclaim the territory of the mainland," he started, "we should promptly and precisely determine our goals for science development." His goals put talents first. "In each [scientific] discipline," Wu asserted, "we must have many people with extensive knowledge about its past and present developments." As talents, these scholar scientists must have the autonomy to formulate "their own insights into the meanings of each question and its development." They must be able to "act independently in, and guide younger generation towards, different levels of research work." Wu argued for establishing a "five- or ten-year plan" so that "within certain years, the nation will cultivate and keep a great number of scientists."[61]

The following winter, the new president of Academia Sinica, Hu Shi (胡適, 1891-1962), embraced Wu's plan and asked for his help. Hu Shi was a philosopher and former ambassador to the United States (1938-1942) who had long advocated independence for academic scholars. As the President of Peking University in 1947, he published a newspaper essay "A Ten-year Plan for Academics' Independence [in China]." In particular, he wanted China to train its own academics in its own universities. Like Wu, he hoped that science scholars could not only do research but also study and inform such policy issues as industrial development and health promotion. He also wanted "scholars and research institutes of our nation" to equal those of the powerful countries of the world so they could "collaborate and share together the duties to advance academic knowledge for humanity." He urged not to build any new universities. He called for transforming five universities into world-class research centers within five years, and then five more within another five years.[62]

At the time when Hu Shi chaired Academia Sinica, his ten-year plan had long been stranded in Mainland China. The KMT lost to the communists all the universities he wanted to develop. Hu Shi would soon acknowledge that he could no longer aim so high in Taiwan, as "[now] we could … only develop one university."[63] In a letter in February 1958, Hu Shi asked Wu to expound on the "five-year or ten-year

[60] Wu Ta-you, "Acadimia Sinica and I" (cit. n. 45), 130; Wu Ta-you, "University Entry Exam and Paths for Our Country's Science Development" (cit. n. 54), 221; Tao Ying-hui, *Dianxing zai suxi: Zhuihuai zhongyang yanjiuyuan liuwei yigu yuanchang (xia)* 典型在夙昔：追懷中央研究院六位已故院長 (下) (Remembering Six Late Presidents of Academia Sinica, Vol. 2) (Taipei: Sow We Publishing, 2007), 115-116.

[61] Wu Ta-you, "How to Develop Our Country's Science (如何發展我國的科學)," in *Kexue yu kexue fazhan* (cit. n. 1) (1986 [1957]), 12.

[62] Hu Shi 胡適, "A Ten-Year Plan for Academics' Independence (爭取學術獨立十年計畫)," *Central Daily News* (Sep. 28 1947).

[63] Hu Shi, "Letter to Wu Ta-you, March 28 1958 [胡適致吳大猷函胡適致吳大猷函(1958年3月28日)]," in Pan Kuang-che 潘光哲 ed., *Hu Shi zhongwen shuxin ji* 胡適中文書信集 4 (The Collected Chinese Letters of Hu Shih, Vol. 4) (Taipei: Institute of Modern History, Academia Sinica, 2018 [1958]), 425.

plan" suggested in his newspaper essay. Hu wanted to make Wu's plan be a kind of "explorer map" as well as "road paving" work for the future of academics in China.[64]

Wu replied a month later with a five-year plan for "developing academic knowledge and cultivating talents."[65] Now quite experienced with the administrative operations of government, Wu knew that any budget proposals for science development would need to coordinate with the priorities of military, economic, and financial affairs. While acknowledging that fundamental research was often overlooked, he also argued that a systemic budget plan would have to include "all the moving pieces," including "politics, the military, finance, economics, and academic research."[66] Hu replied to Wu, assenting to his plan and summarizing it in two points: "first, [budget-wise] the government must make a commitment; and second, all work must start with building science as a foundation."[67]

Drawing on Wu's plan, Hu presented the "Five-Year National Plan to Cultivate Talents for Science Development (國家發展科學培植人才五年計畫的綱領草案)" to Chen Cheng, now vice president and premier, on August 22, 1958.[68] As reported above, Chen had asked Wu in 1947 to help the KMT regime make an atomic bomb when he was head of the Military Administration Department. Both Chen and the minister of education Mei Yi-chi (梅貽琦, 1889-1962) now supported the proposal, with Chen even promising to double the budget. The Executive Yuan formally approved the plan on August 22, 1958.

The next day, the PRC navy made two attempts to land on Quemoy islands, precipitating what would become the Second Taiwan Strait Crisis. Soon thereafter, the Executive Yuan reassessed the talents project, cutting its budget by 50%. The jewel of the plan, a "National Top Decision Committee for Science Development (國家發展科學最高決策委員會)" got scrapped. Its members would have included the President, Vice President, all ministers, and some university presidents.[69]

Getting Scientists into Long-term Science Development

What remained was a plan for a quasi-task force to advocate for infrastructural moves to produce, employ, support, and retain science talents. In February 1959, at the behest of Hu Shi and a number of prominent scientists, the Ministry of Education

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64 Hu Shi, "Letter to Wu Ta-you, Feb. 11 1958 [胡適致吳大猷函(1958年2月11日)]," in ibid., 415.
65 Wu Ta-you, "Letter to Hu Shi, March 11 1958 [吳大猷致胡適函(1958年3月11日)]," in *Zai tai gongzuo huiyi* (cit. n. 3) (1989 [1958]), 51.
66 *Ibid*., 51.
67 Hu Shi, "Letter to Wu Ta-you, March 28 1958" (cit. n. 63), 424.
68 Yang Tsui-hua, "Promoting Science and Scholarship in Taiwan: Hu Shih's Dream of 'Academic Independence' (胡適對臺灣科學發展的推動:「學術獨立」夢想的延續)," *Chinese Studies* (漢學研究) 20:2 (2002), 335-336.
69 *Ibid*.

joined with Academia Sinica to create the National Council on Science Development (國家長期發展科學委員會, hereafter Science Development Council).[70] Actually, the literal translation would read something like National Council on Long-term Science Development, meaning that its focus was not on short-term deliverables and benefits. With such a title and mission, it is not surprising that elite members of Academia Sinica were in control. As its president, Hu served *ex officio* as chairperson, with the minister of education as his deputy. Also, the first council included 23 members from Academia Sinica and only three from the ministry. That ratio would persist for the next eight years. Notably, the long-term council had no exclusive staff or office, further highlighting the stature and status of the members.[71]

That the Science Development Council would operate with considerable autonomy in the interstices of the government proved to be something of a mixed benefit. With limited funding from the Executive Yuan, it turned to the United States' International Cooperation Administration (ICA), Mutual Security Mission to China for assistance. Nearly 90% of the 1959 budget came from the American agency. ICA had recently expanded its purview to include support for science education, and Hu had built a substantial personal network through his years in the United States.[72] Still, the U.S. agency, concerned that KMT officials might deflect funds into personal accounts, stipulated that the majority of funds go to construction projects that could be tangibly seen and measured.[73] Through its first six years, fully 80% of the Science Development Council's budget went to fund the construction of research facilities. Of the remaining 20%, two-thirds paid for research and living expenses for professors and one-third went to support travel expenses for students studying abroad.[74]

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[70] *Ibid*., 336.

[71] National Science Council, *Guojia kexue weiyuanhui nianbao* 國家科學委員會年報 (Annual Report of 1967) (Taipei: National Science Council, 1968), 433-455; National Council on Science Development, *Guojia changqi fazhan kexue weiyuanhui nianbao* 國家長期發展科學委員會年報 (Annual Report from July 1963 to June 1964) (Taipei: National Council on Science Development, 1964), 1; National Council on Science Development, "Policy Guideline of National Council on Science Development (國家長期發展科學計劃綱領)," in *Guojia changqi fazhan kexue weiyuanhui nianbao* (Annual Report from July 1964 to June 1965) (Taipei: National Council on Science Development, 1965 [1959]).

[72] National Council on Science Development, *Guojia changqi fazhan kexue weiyuanhui nianbao* (Annual Report from June 1964 to July 1965) (Taipei: National Council on Science Development, 1965), 334. Also see J. Megan Greene, *The Origins of the Developmental State in Taiwan* (cit. n. 5), 55.

[73] National Council on Science Development, *Guojia changqi fazhan kexue weiyuanhui nianbao* (cit. n. 72), 335; Yang Tsui-hua, "Hu Shih's Dream of 'Academic Independence'" (cit. n. 68), 341.

[74] J. Megan Greene, *The Origins of the Developmental State in Taiwan* (cit. n. 5), 59; Yang Tsui-hua, "Hu Shih's Dream of 'Academic Independence'" (cit. n. 68), 341-342. Other sources said 60% to 70% of the budget was allocated to construction work. See National Council on Science Development, *Guojia changqi fazhan kexue weiyuanhui nianbao* (cit. n. 72), 335; Wang Shih-chieh 王世杰, "Issues of Building the Foundation of Science in Taiwan (台灣的科學生根問題),"

Reliance on the United States Agency for International Development (USAID, which reorganized the ICA and other foreign assistant programs in 1961) became a liability in the early 1960s when the U.S. government restructured its approach to fighting communism. In the U.S.'s official diplomatic view, democracy could flourish and the evils of communism be resisted only if what it called "developing" countries could build the industrial capacity to substitute domestic production for imports and then initiate private sector practices for import substitution and export-led growth. Implementing this new model, the USAID redirected its support for science training away from advanced knowledge practices at the level of research and toward producing college graduates who could fuel industrial expansion. It also began prioritizing funding for projects that supported industry, redirecting the spotlight away from fundamental research.[75]

The Science Development Council's five-year plan bore relatively little fruit by its completion date in 1964.[76] Although 53 professors had been awarded chair status in physical and mathematical sciences and 35 in biological sciences, no Ph.D. in fundamental science had been produced domestically.[77] As late as 1968, the country had established only one doctoral program in physics (National Tsing Hua University, 1967), one in chemistry (National Taiwan University, 1966), and one in electrical engineering (National Cheng Kung University, 1968).[78]

Also, by that point Academia Sinica had a new president, and the Science Development Council had a new chairperson. Hu Shi had died suddenly in 1962. While Chiang Kai-shek had accumulated a long history of intervening in Academia Sinica's elections, he did not always get his way.[79] The academy's members nominated three scholars, including Wu Ta-you. Chiang preferred Wu, likely owing to

in Wuhan University Alumni Association ed., *Wang Shi Jie xiansheng lunzhu xuanji* 王世杰先生論著選集 (Collection of Wang Shih-chieh's Essays) (New Taipei City: Wuhan University Alumni Association, 1980 [1964]), 444.

[75] J. Megan Greene, *The Origins of the Developmental State in Taiwan* (cit. n. 5), 56. In March 1964, the U.S. officially announced the termination of its aid to Taiwan. See Li Kwoh-ting 李國鼎 and Liu Su-fen 劉素芬, *Li Guoding: Wo de taiwan jingyan* 李國鼎：我的台灣經驗 (Li Kwoh-ting: My Taiwan Experience) (Taipei: Yuanliu Publishing, 2005), 128-129.

[76] Wu Ta-you, "Past and Future of Science and Technology Cooperation between China and the U.S. (中美科學技術合作之回顧與前瞻)," in *Kexue yu kexue fazhan* (cit. n. 1) (1986 [1972]), 192.

[77] National Council on Science Development, *Guojia changqi fazhan kexue weiyuanhui nianbao* 國家長期發展科學委員會年報 (Annual Report from July 1966 to June 1967) (Taipei: National Council on Science Development, 1967), 449.

[78] Wu Ta-you, "Our Country's Science Development (我國的科學發展)," in Wu Ta-you ed., *Lun zhu ji* 論著集 (Collection of Essays), *Vol. 2* (Taipei: Institute of Physics, Academia Sinica, 1978 [1968]), 120-121.

[79] Tao Ying-hui, *Dianxing zai suxi (xia)* (cit. n. 60), 138-142; Huang Max Ke-Wu 黃克武, "The Political Career of Gu Mengyu: From Supporting Wang Jingwei to Backing Chiang Kai-shek to Joining the Third Force (顧孟餘的政治生涯：從挺汪、擁蔣到支持第三勢力)," *Bulletin of Academia Historica* (國史館館刊) 46 (2015), 103-168.

his established international reputation and possibly because of his knowledge of nuclear physics.[80] Wu received the most votes in the election; however, he declined to serve.[81] The next year, he moved from Ottawa to New York, accepting a professorship of physics at Brooklyn Polytechnic Institute.

Although the new president of Academia Sinica, Wang Shih-chieh (王世杰, 1891-1981), was a professor of law at Peking University, he continued the search for ways to infrastructure the making, promotion, attraction, and retention of scientist talents during his term (1962-1970). For example, in 1964 Wang initiated an annual Science Seminar to be held over an eight-week period each summer. It was designed to provide a venue for Chinese scientists both at home and abroad to gather together and potentially develop working relations in and around their research. Co-organized with National Taiwan University and National Tsing Hua University, it activated a not-too-hidden agenda to persuade overseas scientists to visit and get to know Taiwan and, hopefully, consider coming to work for longer periods of time.[82] Not surprisingly, given Wu's persistent advocacy over the years, the seminar included only the disciplines of physics, mathematics, and the biological sciences.[83]

After the Science Development Council completed its first five-year plan, Wang led an ambitious new four-year plan to elevate the production and support of science talents. He planned to build five new research centers in the sciences and engineering, with the idea of making them prestigious reservoirs of science talents for the country. The project would further mobilize developing interactions between Academia Sinica and the U.S. National Academy of Sciences.[84] According to the plan, these centers would receive funding both from the KMT government and from sources in the United States.[85] In the first year, they would acquire enough money to attract forty research faculty from the United States and other countries, later increasing the total to one hundred per year. National Taiwan University, Tsing-Hua University, and Cheng Kung University would all participate and benefit. Wang also envisioned the establishment of twenty to thirty graduate programs in the sciences by the end of

80 Chou Hong-Yi, *Wu Dayou: Zhongguo wulixue zhi fu* (cit. n. 42), 385.

81 Wu thought Academia Sinica was underfunded by the government, and that its salary structure was too inflexible to draw distinguished scholars from overseas. He lamented "even someone like Hu Shi had a hard time accomplishing a lot … how am I qualified to do it?" Wu Ta-you, "Acadimia Sinica and I" (cit. n. 45), 131.

82 Wang Shih-chieh, "Opening Remarks for the Summer Science Seminar (暑期科學研討會開幕式報告)," in *Wang Shi Jie xiansheng lunzhu xuanji* (cit. n. 74) (1980 [1964]), 450-454.

83 Wang Shih-chieh, "Issues of Building the Foundation of Science in Taiwan" (cit. n. 74).

84 Yang Tsui-hua, "Wang Shih-chieh and Sino-American Scientific and Scholarly Exchange, 1963-1978: Aid or Cooperation? (王世杰與中美科學學術交流, 1963-1978: 援助或合作?)," *EurAmerica* (歐美研究) 29:2 (1999), 44-49; Wu Ta-you, "Science and Technology Cooperation between China and the U.S." (cit. n. 76), 183.

85 National Council on Science Development, *Annual Report from July 1966 to June 1967* (cit. n. 77), 1-2.

the four-year period.[86]

Wu Ta-you was skeptical. He did agree to help establish the Physics Research (Promotion) Center and re-establish an Institute of Physics at Academia Sinica, serving as director from afar. But how could a country largely lacking scientist talents in physics, mathematics, chemistry, biology, and engineering even get started collecting talents in research centers? The immediate problem they encountered was a product of the very issue they were trying to address. The Science Development Council was unable to find appropriate senior scientists to lead all of the centers. It quickly became clear that the research center for physics would be the only one on track. The new center for engineering research, for example, experienced severe problems with its leadership.[87]

Perhaps most revealing was the fact that Wang's four-year plan actually attracted little notice from the executive administration. Li Kwoh-Ting (李國鼎, 1910-2001), then Minister of Economic Affairs (1965-1969), mistakenly believed that the plan was not being implemented.[88]

Displaced by Military and Industry Initiatives

Wu Ta-you's moment finally came in 1967. As we mentioned at the outset, President Chiang Kai-shek appointed him to lead the new Advisory Committee for Science Development (科學發展指導委員會). It was intended to be an advisory agency for Chiang, making Wu effectively the President's chief science advisor.[89] At the time, Wu was chairing the department of physics at State University of New York at Buffalo (SUNY Buffalo), a position he had joined two years earlier. Chiang actually permitted him to continue residing in the United States, working half-time on the new committee.[90] Wu was enthusiastic. For the first time since the formation of the KMT government in 1928, he later said in an interview, its government had committed to developing and implementing what he considered a true science policy that

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[86] Wang Shih-chieh, "The Goals and Plans for Long-Term Science Development (長期發展科學的目標與計劃)," in *Wang Shi Jie xiansheng lunzhu xuanji* (cit. n. 74) (1980 [1966]), 327-330.

[87] Wu Ta-you, "Our Country's Science Development" (cit. n. 78), 67.

[88] Li Kwoh-ting et al., *Li Guoding: wo de taiwan jingyan* (cit. n. 75), 482. Cf. Greene's developmental state argument that the Science Development Council was "myopic," paying "[l]ittle to no attention . . . to the big picture" because it was self-interested. J. Megan Greene, *The Origins of the Developmental State in Taiwan* (cit. n. 5), 62, 61. Our argument is that Wu saw a different big picture.

[89] Wu Ta-you, "The Issues of Disbanding the Advisory Committee for Science Development (裁撤科導會問題)," in *Wo de yi sheng* (cit. n. 32) (1992 [1980]), 162-163. Wu compared his Advisory Committee to the American counterpart of his time, that is, the American Office of Science and Technology under John Kennedy. Wu Ta-you, "The Development of Science in the U.S." (cit. n. 1), 212-215.

[90] Wu Ta-you, "Chiang Kai-shek and Science Development in Our Country" (cit. n. 3), 70-71.

would put talents first.[91] Or had it?

The positioning of the committee could certainly lead one to believe so. It was one of four advisory committees in the newly-established National Security Council that Chiang had located in the Office of the President. The other three advised the President on the issues of national construction (國家建設計畫委員會), administration in war zones (戰地政務委員會), and general national mobilization (國家總動員委員會). From his new position, Wu would have authority to coordinate with advisers in other areas to produce a comprehensive national plan that recognized the crucial role of science talents. As he saw it, the government had steered away from the expediency of short-sighted plans and was now affirming the importance of systemic science policy that would coordinate with "national defense, economy, education, etc."[92]

In addition, the President approved transforming the Science Development Council into the new National Science Council (國家科學委員會), elevating it from a task force into a unit in the Executive Yuan, and appointing Wu to lead it. The Advisory Committee for Science Development would formulate policy practices, gaining the approval of the president, and then direct the Science Council to implement them. Wu would serve as a government official charged with supervising both the formulation of science policy and its implementation. It was finally an opportunity to do comprehensive policy work based on fundamental science.[93] Wu started by requesting an annual budget of approximately USD 10 million.[94] He received USD 13 million.[95]

As J. Megan Greene put it, the "placement of the new committee under the National Security Council suggests that its first priority would be matters of national defense [against the PRC]…"[96] For the past three years, the KMT government had been responding to what it considered to be a grave risk to the ROC. When the PRC government on the mainland successfully tested an atomic bomb, Chiang had committed to do likewise. Furthermore, the evident instabilities from the Cultural Revolution added uncertainties that could prove to be opportunities, or new types of threats. Security had become a systemic issue. Chiang Ching-kuo (蔣經國, 1910-1988), Chiang's son, was participating in a secret effort to build a nuclear weapon.[97]

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[91] Laurence Schneider et al., "My Memories and Experience about Pursuing Science" (cit. n. 32), 110; Yang Tsui-hua, "Wu Ta-you and the Commission for Science Development" (cit. n. 43), 75-76.

[92] Wu Ta-you, "Chiang Kai-shek and Science Development in Our Country" (cit. n. 3), 68-69.

[93] *Ibid*., 67-76; Yang Tsui-Hua, "Wu Ta-you and the Commission for Science Development" (cit. n. 43), 75-76.

[94] Laurence Schneider et al., "My Memories and Experience about Pursuing Science" (cit. n. 32), 110.

[95] Yang Tsui-hua, "Wu Ta-you and the Commission for Science Development" (cit. n. 43), 84-85.

[96] J. Megan Greene, *The Origins of the Developmental State in Taiwan* (cit. n. 5), 77.

[97] David Albright et al., "Taiwan: Nuclear Nightmare Averted" (cit. n. 2), 56.

Just as he had in 1945, Wu tried to persuade Chiang Kai-shek to invest first in the fundamental sciences rather than going directly into weapons development.[98] His issue was not an ethical one. In a 1967 letter to Chien Shih-Liang (錢思亮, 1908-1983), then president of National Taiwan University, Wu judged that Chiang Kai-shek had two goals he wanted to achieve through the Advisory Committee on Science Development. The first was in line with Wu's ambitions, that is "to formulate plans for industrial and economic development, on a larger scale of science, engineering and technology, than can be made by the current agencies (e.g. the National Science Council)." And the other, he wrote, was "to carry out a project for the development of nuclear work." Wu was excited about the first. He believed the government should make a genuinely comprehensive plan and had the capacity to do it. He also revealed to Chien that in 1957 he had wanted to advise the government to form "a top decision-making agency ... that could make comprehensive policy for military, economic, and educational affairs," but he lost his confidence after leaving Taiwan and gave up. He now felt his dream was about to come true.[99]

At the same time, Wu shared with Chien that he saw two problems with a plan to build nuclear weapons: lack of resources and of talents. On resources: to make nuclear weapons, we might need to "spend more than half of electricity in the island." On talents: "Although we had many nationals who studied physics and engineering … we could hardly find even a handful of those who had relevant experiences [in nuclear weapons]." His conclusion once again: "We had to develop from the very bottom." Even he considered his own knowledge and specialty as a physicist not relevant to applications in nuclear science. "If I had anything to offer for the project," he said, it was at best "some common sense and mediocre understandings."[100]

In his report to the President in July 1967, Wu also called attention to the issues of cost and military strategy. He estimated that actual spending on developing atomic weapons would be far more than USD 140-150 million, a number drawn from a German provider, Siemens.[101] And if the ROC produced its own atomic weapons, he argued, it would give the PRC an excuse to attack. Taiwan was too small to endure such an attack. Then there was the complex issue of developing missiles to carry bombs. And, finally, his everlasting concern: "we need … between thousands of and tens of thousands of workers in science, engineering, and technology."[102] In sum,

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[98] *Ibid*.
[99] Wu Ta-you, "Letter to Chien Shih-Liang," in *Zai tai gongzuo huiyi* (cit. n. 3) (1989 [1967]), 71-72.
[100] *Ibid*., 72.
[101] Wu Ta-you, "A Historial Ducument: A Supplement to Our Country's History of Nuclear Policy (一項歷史性文件: 我國核能政策史的一個補註)," in *Zai tai gongzuo huiyi* (cit. n. 3), 78-79. See also ibid., 82.
[102] *Ibid*., 81-82.

Wu had no intention to help develop nuclear weapons.[103]

The emergent nuclear policy was routed through the military agency established in 1965, the National Chung-Shan Institute of Science and Technology (國家中山科學研究院). It quickly consumed fully half of the Executive Yuan's total budget for scientific research and development. Meanwhile, the minister of economic affairs, Li Kwoh-Ting, was beginning to build and implement a different approach to policy planning that would elevate engineering knowledge and research rather than fundamental research in the sciences. He hoped that the two Chiangs would abandon the grand plan to reclaim the mainland and commit to developing Taiwan's economy.[104]

In 1966, Li initiated the Modern Engineering and Technology Seminar in coordination with the New York chapter of the Chinese Institute of Engineers. The seminar brought together Chinese-American experts to discuss engineering topics of interest to industries in Taiwan. The seminar would later win credit for helping to found the semiconductor and information technology (IT).[105] Li also followed closely the activities of the Korea Institute of Science and Technology (KIST), founded in 1966 to provide research support for the heavy and chemical industries. His efforts to build a Taiwanese version ultimately led to the founding of the Industrial Technology Research Institute (ITRI) in 1973.[106]

Wu tried to counter Li's initiatives. He reasserted his position that the fundamental sciences provide the basis for industrial technology, just as it did in other areas of development. Hence, the Korean KIST model was inappropriate for the ROC.[107] He claimed that Li's strategy depended so much on low labor costs and low technology that it could hurt the country's long-term developments in science.[108] He complained that Li and other ministers interested in promoting industry took 25% of the budget for scientific research and development.[109]

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[103] Cf. Wu Ta-you, "Letter to Chien Shih-Liang" (cit. n. 99), 71; Wu Ta-you, "Chiang Kai-shek and Science Development in Our Country" (cit. n. 3), 68.

[104] Li Kwoh-ting, *The Development of Science and Technology Policy in Taiwan: The Reminiscences of K.T. Li* (李國鼎先生訪問紀錄：臺灣科技政策發展) (Taipei: Institute of Modern History, Academia Sinica, 2020), 25.

[105] Shih Yen-shiang 施顏祥, ed., *Jindai gongcheng jishu taolunhui shijie jinian zhuanji* 近代工程技術討論會十屆紀念專集 (A Memorial Collection of the Tenth METS Conference) (Taipei: Chinese Institute of Engineers, 1985).

[106] Li Kwoh-ting, *The Development of Science and Technology Policy in Taiwan* (cit. n. 104), 23, 49, 298.

[107] Wu Ta-you, "Letter to Mr. Chiang Yen-shi: Obstacles during My Term at National Science Council (給蔣彥士先生的一封信：國科會初期工作的阻擾)," in *Zai tai gongzuo huiyi* (cit. n. 3) (1989 [1973]), 89-92; Wu Ta-you, "Two Different Possible Policies for Science Development (發展科學兩個不同的可能政策)," in Wu Ta-you ed., *Boshi fang kuai* 博士方塊 (My Intellectural Comments on Public Affairs) (Taipei: Yuanliu Publishing, 1987); Wu Ta-you, "Science and Technology Cooperation between China and the U.S." (cit. n. 76), 183.

[108] Wu Ta-you, "Letter to Mr. Chiang Yen-shi" (cit. n. 107), 89-90.

[109] *Ibid*., 92-93.

Ultimately, Wu's vision lost out on both counts. His unwillingness to support the development of nuclear weapons prompted the Chiangs to keep their distance from him. At its first few meetings, the Advisory Committee had secured both the minister of finance (Li) and minister of Economic Planning Council as members. Both dropped out quickly. Even Lee Teng-Hui (李登輝, 1923-2020), a high-ranking bureaucrat in agriculture who later became president of the country, also declined to attend after a few meetings.[110]

By 1970, the advisory committee had lost most of its strength. Together, the committee and the Science Council received only 20% of the R&D budget. The summer Science Seminar was cancelled after 1971.[111] After Chiang Ching-kuo was promoted to premier in 1972, Wu's advisory committee "had no work to do."[112] And in 1973, his continuing position as a physics professor in New York and half-time availability cost him his position as an official in the ROC government.[113]

Conclusion: Stuck on the Surface of Science

In 1971, as the Advisory Committee for Science Development was in decline, Wu lamented that China had misunderstood the power of the West during the last decades of the Qing dynasty. Having been defeated time and again by "solid ships and effective weapons," it made the mistake of seeing Western power as based on guns and warships, and rushed into buying munitions, factories, steel plants, and shipyards. What China did not understand, Wu maintained, was that it was seeing "only the surface of Western science." It did not know and understand the "scientific foundations for the material civilization of the West," but rather "some achievements of the application of science."[114] Although not stated explicitly, the clear implication was that the misunderstanding was happening again.

Wu Ta-you was no Confucian. Indeed, when he reflected on his life and work at the age of eighty, he asserted that he had rarely thought about deep questions such as "cultural beliefs and philosophy of life." He did say that, as a child, he had learned about ethics and morality from his family, especially his mother. He got a "strong impression" of the four cardinal principles (propriety [禮], righteousness [義], integrity [廉], and shame [恥]) and eight virtues (loyalty [忠], filial piety [孝], benevolence [仁], love [愛], honesty [信], justice [義], harmony [和], and peace [平]) of Confucian morality that Chinese people practice in their lives. At the same time, his

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[110] Yang Tsui-hua, "Wu Ta-you and the Commission for Science Development" (cit. n. 43), 97-98.
[111] Wu Ta-you, "Policy and Measures for Our Country's Science Development (我國科學發展的政策與措施)," in *Kexue yu kexue fazhan* (cit. n. 1) (1986 [1971]), 48-49.
[112] Wu Ta-you, "A Chronicle of My Life at Eighty-Five" (cit. n. 33), 358.
[113] Yang Tsui-hua, "Wu Ta-you and the Commission for Science Development" (cit. n. 43), 80-81.
[114] Wu Ta-you, "Policy and Measures for Our Country's Science Development" (cit. n. 111), 41.

schooling had made him an "extremely rational person." As a result, he had neither sought to restore ancient Chinese "things" nor allowed himself to be "intoxicated" by an indiscriminate or blanket acceptance of Western "things."[115]

During our research, we never found Wu Ta-you to couch in explicitly moral terms his vision of long-term, fundamental science as the genesis of human material civilization. Indeed, he frequently eschewed images of himself as a kind of master who exerted moral leadership. At the same time, he enacted a career-long commitment to realizing this vision by working to cultivate fundamental researchers who could become societal leaders, including by working for and within government. In contrast with an American approach to funding basic research and researchers, he did not insist on their autonomy. In contrast with the work of technocrats, as he portrayed them, Wu argued against limiting planning for industry and military development to short-term goals and objectives. Like the infrastructure of the civil service exam, whose practices have both changed and lived on in Chinese public school and college entrance examinations,[116] this analysis suggests that Wu Ta-you was building an identity for scientists that drew on the past identity of the elite scholar-official, even as he changed it.[117] That is, he was trying to cultivate scientists into becoming a new kind of scholar-official.

After losing the directorship of the National Science Council in 1973, Wu led the Advisory Committee to focus on issues in science education. He worked with the Ministry of Education to build support for scientists to receive their Ph.D. training in Taiwan and then do postdoctoral work abroad. Staying in Taiwan long enough to complete their degrees would help them establish strong local professional and personal connections over the years and increase the chances they would return to Taiwan after finishing their postdoctoral training abroad. He hoped that advanced scientists would be in Taiwan long enough and "build up a deeper understanding and compassion for the country."[118]

Despite continuing to honor scholars and making some effort to integrate them into governance, the KMT government never fully committed to long-term science development sufficiently to put talents first. In Wu's terms, the ROC remained stuck on the surface of science.

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[115] Wu Ta-you, "Expressing My Thoughts at Eighty (八十述懷)," in *Bashi shuhuai* (cit. n. 54) (1987 [1986]), 83.

[116] Benjamin A. Elman, *A Cultural History of Civil Examinations in Late Imperial China* (Berkeley: University of California Press, 2000); Yeh Wen-Hsin, *The Alienated Academy* (cit. n. 18).

[117] In 2001, a former student wrote that Wu had "devoted his whole life to the Chinese nation's cultural development, inherited our moral tradition long time ago, and facilitated contemporary progress of science." Lee Tsung-Dao, "Mourning Teacher Wu Ta-you (悼吳大猷老師)," in *Dianfan yongcun* (cit. n. 42), 34.

[118] Wu Ta-you, "The Issues of Developing Our Country's Advanced Academic Talents (我國高級學術人才的培育問題)," in Wu Ta-you, *Jiaoyu wenti* 教育問題 (The Issues of Education) (Taipei: Yuanliu Publishing, 1992 [1985]), 124.

Abstract

A main theme in the history of science policy in Taiwan concerns the positioning of science infrastructures in nation building and rapid economic growth. This article calls attention to another evolving initiative in science policy in the Republic of China (ROC), one that emphasized the production of talents who could become societal leaders, including by working for and within government. We trace the emergence of this initiative through the career of Wu Ta-you, who grew up in mainland China, earned his Ph.D. in the United States, and worked on the margins of reconstruction during the 1930s. Through the 1950s, he played a leadership role advocating for long-term planning to develop fundamental researchers in science in Taiwan. His moment appeared to come in 1967 when he became the president's chief science adviser. His efforts to develop science talents were soon displaced, however, by emerging shorter-term initiatives to support the military and industry. Clearly not contributing as an instrumental technocrat nor a proponent for autonomous basic research, was he attempting to combine the identity of a scientist with that of the Chinese scholar-official? By taking science policy in a different direction, the ROC, in Wu's terms, remained stuck on the surface of science.

Keywords: Wu Ta-you, science infrastructures, science policy in Taiwan, scholar-officials, scientist identity