

# A Cradle of Chinese Physics Researchers

*The Master of Science Program in the Physics  
Department of Yenching University, 1927–1941*

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## Introduction

This chapter examines, for the first time, the development of the Master of Science (MS) program in physics at Christian Yenching University in Beijing<sup>1</sup> and compares its accomplishments with that of its counterparts at Peking and Tsinghua universities. Yenching University ('Yenching' hereafter) was born from the union of four missionary institutions around Beijing between 1915 and 1920.<sup>2</sup> As of 1925, Yenching already ranked among the top ten universities in China, both public and private.<sup>3</sup> Physics instruction appeared to have been available at Yenching from the beginning,

<sup>1</sup> During the first half of the 20th century, the city of Beijing was also referred to in the West as Peking or Peiping. Except for direct quotes from primary sources and institutions' proper names, I refer to the city as Beijing throughout.

<sup>2</sup> Philip West, *Yenching University and Sino-Western relations, 1916–1952*, Harvard East Asian Series (Cambridge, MA, 1976), 34–5.

<sup>3</sup> A study at the University of California in the mid-1920s rated Yenching University 'Class B', meaning that its graduates 'might be permitted to enter graduate schools in the United States without deficiencies'. Only one other mission college and eight government institutions in China received the same or higher rating. See Yoshi S. Kuno, *Educational Institutions in the Orient, with Special Reference to Colleges and Universities in the United States* (Berkeley, CA, 1928), 56; Jessie Gregory Lutz, *China and the Christian Colleges, 1850–1950* (Ithaca, 1971), 202; ZHANG Weiying, WANG Baiqiang, and QIAN Xinbo, *Yanjing daxue shigao 1919–1952* (A draft history of Yenching University) (Beijing, 2000), 16. In Kuno's ranking, the four top rated 'Class A Universities' were Peiyang, Tang-Shan, and Tsing Hua universities and the College of Agriculture of the University of Nanking; following them were seven 'Class B Universities': Conservancy (or Hohai) Engineering College, The Fourth National Chung-Shan (National Southeastern) University, Nanyang (The First Chiao-Tung) University, the University of Hong Kong, the University of Nanking, Yenching University, and National University of Peking. See Kuno, *Educational Institutions*, 55–6.

because it had previously existed in its constituent missionary institutions. Such instruction at Yenching was first carried out in collaboration with the Premedical School of Peking Union Medical College (PUMC).<sup>4</sup> In 1927, Yenching established the first MS program in physics in China, from which nearly three dozen Chinese students graduated before 1941—more than half of whom would become prominent physics researchers. It was this MS program that transformed the Yenching Department from a largely premedical training center serving the PUMC into a prominent cradle of physics researchers in Republican China. This Yenching Department, despite its small faculty and brief existence, nurtured many eminent Chinese physicists, which reveals significant but often overlooked Western contributions to Chinese science in the early twentieth century through missionary colleges alike.

### Paul Anderson and the Inauguration of the Master of Science Program

In the early years, there were only a few students enrolled in the Department of Physics at Yenching University, whose mission was to prepare premedical students for the PUMC. It was not until 1922 that the department produced its first Bachelor of Science (BS). Physics enrollment remained scant in the 1920s. Between 1922 and 1929, a total of only nine students received their BS degrees in physics at Yenching.<sup>5</sup> A significant transformation, however, began during 1925–1926 as a result of the closure of the Premedical School of the PUMC and the change of the department's leadership.

In 1917, the PUMC established its own Premedical School because other schools in China were unable to supply qualified applicants with adequate scientific training. By the summer of 1925, the science departments at Yenching and other colleges and universities in China had made so much

<sup>4</sup> The PUMC, established in 1915 and funded by the Rockefeller Foundation, was designed to promote modern medical education in China and went on to become 'the most famous medical education and research center' in not only China but 'all of Asia'. Qiusha Ma, 'The Peking Union Medical College and the Rockefeller Foundation's Medical Programs in China,' in William H. Schneider (ed.), *Rockefeller Philanthropy And Modern Biomedicine: International Initiatives from World War I to the Cold War* (Bloomington, 2002), 179.

<sup>5</sup> These statements are based on my study of the following: *Yanjing lixueyuan xiaoyou xiaoxi* (Yenching's School of Natural Sciences Alumni News) (Beijing, 1934), deposited at Peking University Archives in Beijing, China, 15–16; *Wuli xuexun* (Physics News, the Department of Physics and the Physics Club of Yenching University) 8 (1940). *Yenching University Bulletin, Directory of Faculty and Students* in relevant years; and Chieh-san LIU's thesis deposited at Peking University Library. It was previously claimed that CHOU Chiyun 周啟運 earned her BS in this department in 1925; see PAN Yongxiang 潘永祥, WU Ziqin 吳自勤, and FAN Shulan 范淑蘭, 'Yanjing daxue wuli xuexi shigao' (A draft history of the Physics Department at Yenching University), *Wuli* (Physics), 22/8 (1993), 494. But her BS was actually in mathematics (see the *Alumni News* above, 18).

progress that they could replace the primary function of the Premedical School. As a result, the China Medical Board of the Rockefeller Foundation decided to close the Premedical School and turn it over to Yenching in 1926 when the latter began to move to its brand new and greatly expanded campus near the imperial Summer Palace (in the west suburb of Beijing). The merger, which included the transfer of the complete library and entire collection of equipment and apparatuses of the Premedical School to Yenching University, was another significant and substantial boost to the development of Yenching's department of physics. Moreover, at least one physics faculty member of the Premedical School, D. K. Yang, found his new academic home at Yenching.<sup>6</sup>

In January 1926, Corbett, who was on furlough in America, unexpectedly resigned from both the University and his mission.<sup>7</sup> Paul Alexander Anderson (1898–1990), who came to Yenching in 1925 and was serving as the department's acting chairman while Corbett was away, succeeded the latter. Born in Chicago on November 26, 1897, Anderson earned his Bachelor degree at University of Illinois in 1920. He then spent one academic year (September 1920–June 1921) at University College in London before attending Harvard University in fall 1921. While studying at Harvard, Anderson also began to work at Eastman Kodak Company Research Laboratory in July 1923. In June 1925, he received his Ph.D. in physical chemistry at Harvard, supervised by Theodore W. Richards, winner of the Nobel Prize for chemistry in 1914. Upon receiving his doctorate, Anderson left Eastman Kodak Company in July and accepted the joint appointment of Yenching University and Rockefeller Foundation. Arriving at Yenching with his wife, Anderson was initially appointed as an 'Instructor in Physics' and 'Acting Head' of the department of physics, who became the department's full 'Chairman' in 1927.<sup>8</sup>

<sup>6</sup> Dwight W. Edwards, *Yenching University* (New York, 1959), 161. The merger could have taken place as early as the summer of 1925 when the Premedical School was closed, Mary E. Ferguson, *China Medical Board and Peking Union Medical College; a chronicle of fruitful collaboration, 1914–1951* (New York, 1970), 39. The transfer of the library and equipment: MENG Chao-Ying 孟昭英, 'Yanjing daxue wulixi de bianqian' (The evolution of the Department of Physics at Yenching University), *Wuli*, 11/11 (1982), 653.

<sup>7</sup> Archives of the United Board for Christian Higher Education in Asia, RG 11, 324–4957, Special Collections, Yale Divinity School Library, New Haven, CT. Reactions of Stuart and the Mission to Corbett's resignation: Smith and Corbett, 75.

<sup>8</sup> For sources of Anderson's biographical data, see: NAS Archives, NRC Rockefeller Fellowships, Fellowship Applications, Paul Alexander Anderson, 1929–31. Deposited at National Academy of Sciences, Washington, D.C., U.S.A. Cheryl Gunselman, the manuscripts librarian at Manuscripts, Archives, and Special Collections Washington State University Libraries, e-mail message to author, 4 August 2016; National Research Council (U.S.), *National Research Fellowships, 1919–1944: Physical Sciences, Geology and Geography, Medical Sciences, Biological Sciences* (Washington, D.C., 1944), 25; Sabrina Zearott, '95 Years of Physics: The Department, Its Leaders, And The Research That Helped Make It



**Figure 13.1** Paul A. Anderson in 1924. (Special Collections, Divinity Library, Yale University, The United Board for Christian Higher Education in Asia Records, RG 11, 421-5927, 7201)

Under Anderson's leadership, the department began to reform. As Corbett predicted, 'Progress [in the physics department] will be more rapid under the younger and better trained men.'<sup>9</sup> Along with other science departments at Yenching, the Department of Physics attempted 'to extend its scientific work beyond the premedical level, offering additional courses and engaging in important research.'<sup>10</sup> Anderson expanded Yenching's physics curricula with new courses such as thermodynamics, advanced electricity and magnetism, direct-current electrical measurements, mathematical methods in physics, and modern developments in physics.<sup>11</sup>

Anderson was a passionate practitioner and promoter of physics research who believed that research was not merely 'part of the graduate training process' but also 'a normal activity for any trained physicist or physics professor'.<sup>12</sup> Under his leadership, the department raised the bar for the

Great', *Physics Matters - Washington State University Department of Physics & Astronomy*, 17 (2014), 22–5. Anderson's dissertation was titled 'I. The Electrochemical Behavior of Liquid Barium Amalgams. II. The Activity of Hydrogen Desorbed from Platinum and Palladium' (<http://id.lib.harvard.edu/aleph/003739931/catalog>, accessed on 1 August 2016). Anderson's appointment at Yenching, see *Colleges of Arts and Sciences: Announcement of Courses, 1925–26*, *Yanjing daxue xuebao* (hereafter Yenching University Bulletin), vii.21 (Beijing, 1925), 46; *Announcement of Courses 1927–28* (note 4), 54; Pan, Wu, and Fan, 'A Draft History of the Physics Department', 494. *Yenching University Bulletin*, x.21 (Beijing, 1927). I used the copy of *Yenching University Bulletin* in Special Collections, Divinity Library, Yale University, The United Board for Christian Higher Education in Asia Records, RG 11, 308-4745, x–xi.

<sup>9</sup> Archives of the United Board for Christian Higher Education in Asia, RG 11, 324-4957, Special Collections, Yale Divinity School Library, New Haven, CT. January 8, 1926.

<sup>10</sup> Edwards, *Yenching University*, 161.

<sup>11</sup> *Announcement of Courses, 1927–28*, 55.

<sup>12</sup> Zearott, '95 Years of Physics', 24.

awarding of BS degrees in physics, stressing 'original investigation'. To receive the BS degree, Anderson decreed that students not only should earn a certain number of credits in physics, mathematics, chemistry, and sociology, but must also complete a thesis that comprised 'a simple original investigation and the preparation of a bibliography and historical resume of previous work in the field, with practice in the use of the original literature'.<sup>13</sup> Correspondingly, Anderson launched 'Senior Thesis', a new course required for undergraduate students in the physics major, during the 1926–27 academic year. In this course, Anderson encouraged students to prepare '[a] historical and critical resume of some branch of physics, a careful redetermination of an important constant, or a simple original investigation, as decided in conference with the staff'.<sup>14</sup>

In 1927, Anderson established a Master of Science Program in physics—the very first such program in the country.<sup>15</sup> To earn the new MS degree at Yenching, the students needed to demonstrate their 'ability in original investigation'. This ability was 'construed as including: (1) a thorough understanding of the method fundamental to all scientific research; (2) the necessary command of experimental technique, and especially (3) initiative in carrying forward a problem without the detailed direction of the instructor. The ability to translate scientific German at a practicable rate [was] also required'.<sup>16</sup> To help students meet the new requirements, he offered another new course, 'Graduate Research,' with two objectives: to direct 'graduate students with the necessary training' to 'undertake original work', utilizing the department's facilities of equipment; and 'to teach the fundamentals of method and technique' to those without research experience.<sup>17</sup> Anderson's first graduate student, Pei-hsiu WEI, earned his Master's degree in 1929 with a thesis titled 'Chemical Decomposition of Silver Oxide by Slow Electrons', in which Wei attempted to determine the critical electron velocity or energy for decomposition of a silver oxide film. Anderson had suggested the problem to Wei and recommended the method used in this thesis.<sup>18</sup>

<sup>13</sup> *Announcement of Courses 1927–28*, Curricula, xi.

<sup>14</sup> *Announcement of Courses, 1926–27*, 44.

<sup>15</sup> Pan, Wu, and Fan, 'A Draft History of the Physics Department', 494; DONG Guangbi, *Zhongguo xiandai wulixue shi* 中國現代物理學史 (A history of modern physics in China) (Jinan, 2009), 5.

<sup>16</sup> *Announcement of Courses 1927–28*, Curricula, xi.

<sup>17</sup> *Ibid.*, 56.

<sup>18</sup> Dong, *Zhongguo xiandai wulixue shi*, 5; Yenching University College of Natural Sciences, 'Statement Presented to the Rockefeller Foundation', October 1929, in *Archives of the United Board for Christian Higher Education in Asia, RG II, 64A-843*, deposited in Special Collections, Yale Divinity School Library, New Haven, CT, 55; WEI Pei Hsiu 魏培修, 'Chemical Decomposition by Slow Electrons' (M.S. Thesis, Yenching University, 1929), 1, 22, 23.

Anderson particularly valued experiments in physics education. This special appreciation of experiments soon became a characteristic feature of the department. He worked hard to improve the department's laboratories, constructing many experimental instruments himself, for instruction as well as for research. One of his contributions of long-lasting impact was the machine shop he established in the department. He even trained two mechanics, one for metalwork and the other for woodwork.<sup>19</sup>

In addition to his administrative work, lectures, and responsibility to supervise students' theses, Anderson carried out his own experimental investigations, studying the purification of barium, demonstrating his distinguished experimental skill and bringing advanced apparatuses to the department. In January 1928, he published his research results in a paper titled 'The Electromotive Behaviour of Single Metal Crystals' in *Nature*.<sup>20</sup>

The department was advancing its quality in teaching and research under Anderson's leadership when he unexpectedly resigned from the chairmanship in September 1928—his wife had suddenly died, likely from childbirth, leaving him an infant boy to take care of.<sup>21</sup> Nevertheless, he seems to have continued teaching at Yenching in fall 1928 since his salary arrangements there did not expire until the end of January 1929. This was probably because it was too late to cancel his scheduled courses that fall.<sup>22</sup>

Anderson returned to America at the beginning of 1929 and immediately applied for the prestigious American National Research Fellowships (NRF) in Physics, Chemistry, and Mathematics. By the end of January, he was awarded the annual Fellowship, which was later renewed twice, eventually extending the normal twelve-month NRF tenure to an extraordinary one of twenty-eight months (February 1929–June 1931).<sup>23</sup> While the success of Anderson's application for the NRF reveals the

<sup>19</sup> Pan, Wu, and Fan, 'A Draft History of the Physics Department', 494. Quotes about the training of mechanics: Records of the Council for World Mission, Box 27, 2073, London Missionary Society Archives at School of Oriental and African Studies Library, University of London in London, U.K.

<sup>20</sup> Pan, Wu, and Fan, 'A Draft History of the Physics Department', 494. Quotes about Anderson's experimental study at Yenching: Anderson's 1928 paper: Paul A. Anderson, 'The Electromotive Behaviour of Single Metal Crystals', *Nature* 123/3089 (1928).

<sup>21</sup> NAS Archives, NRC Rockefeller Fellowship Applications, Paul A. Anderson. Anderson's son was born in either August or early September 1928. Mrs. Anderson, named Marion Parker Perrin before her marriage, graduated with a BA from Wellesley College in 1922. (<https://newspaperarchive.com/boston-evening-globe-jun-20-1922-p-9/>, accessed on June 12, 2018)

<sup>22</sup> *Ibid.*, Anderson had been scheduled to teach five courses in 1928–29 academic year; see Yenching University, *Benke kechengyilan* 本科課程一覽 (Announcement of Undergraduate Courses) 1928–29 (Beijing, 1928), 47–52.

<sup>23</sup> NAS Archives, NRC Rockefeller Fellowship Applications, Paul A. Anderson.

significance of his investigation at Yenching, the repeated extensions of his NRF clearly attests Anderson's eminence as a young American researcher.

Upon the completion of his NRF fellowship in the summer of 1931, Anderson accepted the appointment at Washington State College in Pullman, Washington, where he chaired the Department of Physics, starting in September 1931, for the next 30 years.<sup>24</sup> In his first ten years at Pullman, Anderson had two distinguished accomplishments: he was the first investigator to achieve ultra-high vacuum conditions ( $P < 10^{-11}$  Torr), a feat so extraordinary that it 'could not be measured or reached by other laboratories for 20 years', and he constructed the first electron microscope outside of Germany.<sup>25</sup> Anderson's post-1929 accomplishments characterize him as not only an extraordinarily skillful experimentalist but also an adept administrator—one embraced by his colleagues. One cannot help but wonder how much more he might have done for the development of Yenching's physics department had he stayed there longer. More than half a century after Anderson's departure from China, Meng, now a prominent Chinese physicist, still vividly remembered Anderson as 'a knowledgeable physicist who actively initiated and promoted extracurricular scientific investigations, shepherding and supervising students' research-based thesis work'.<sup>26</sup>

### Y. M. Hsieh: The First Chinese Chair in the Physics Department

The unexpected early departure of Anderson was a big loss for the physics department at Yenching, but it also provided an opportunity for Yu-Ming Hsieh to take charge of the department. Hsieh would be the first Chinese to do so in the department's history, and likely sooner than the university intended.<sup>27</sup>

<sup>24</sup> National Research Council Questionnaire, in *ibid*, and Zearott, '95 Years of Physics', 24.

<sup>25</sup> In his attempts to measure the 'work functions'—the energy required to release an electron from the surface of a metal—of metals in the early 1930s, Anderson achieved the ultra-high vacuum conditions. See Edward E. Donaldson and J. Thomas Dickinson, *Pioneering Research on Work Functions in Ultra-High-Vacuum at W.S.U.* (unpublished), (Department of Physics and Astronomy, Washington State University, 1998). The quote appears in Zearott, 24. Working with Kenneth Fitzsimmons at WSC in 1935, Anderson constructed this early electron microscope. See 'A Story of Two Washingtons: The Earliest Electron Microscopes in America', <https://www.microscopy.org/images/posters/washington.pdf> (accessed on 4 August 2016).

<sup>26</sup> Meng, 'The Evolution of the Department of Physics at Yenching University', 653.

<sup>27</sup> In his letter of resignation in January 1926, Charles Corbett had urged Yenching's trustees to consider putting Hsieh or D.K. Yang in charge of the physics department 'as soon as possible'. However, the university apparently did not feel that either of these two Chinese physicists was ready and decided to let Anderson head the department at least for a period of transition. (See Charles H. Corbett to Peking University Trustees, January 8, 1926.)



Born in a poor family and raised by his widowed mother alone in Fujian, China, Hsieh received his early education in church schools. Upon his graduation from Westminster College (培元中學), a secondary missionary school in Quanzhou, Fujian, he was admitted to the North China Union College on recommendation. After earning his B.A. at Peking University<sup>28</sup> in 1917, Hsieh taught physics and mathematics at Westminster College until 1921 when he returned to Beijing at the invitation of Corbett, Hsieh's past physics professor at NCUC.<sup>29</sup> During 1921–1923, Hsieh not only served as an instructor of physics at Yenching, but also took courses in physics and physical chemistry at the Premedical School of the PUMC, an experience that apparently kindled his desire to study physics in America. Corbett, President Stuart, and Howard S. Galt at Yenching strongly supported Hsieh's plan to study in America, as did Mr. Bird R. Stephenson of the Premedical School and Mr. Nathaniel Gist Gee—an adviser to the Chinese Medical Board (CMB) of the Rockefeller Foundation and former science professor of Soochow University. In February 1923, the CMB granted Hsieh 'a fellowship for study of pre-medical subjects in America or Europe for one year beginning approximately August 1, 1923'.<sup>30</sup>

Hsieh began his study abroad at Columbia University in New York City, where he took at least nine courses, eight in physics and one in mathematics, between September 1923 and June 1924, earning an A.M. By February 1924, Hsieh had informed the CMB that he wished to study in America one more year, requesting a renewal of his fellowship. The CMB thus investigated Hsieh's performance at Columbia by interviewing Professors Pegram, Davis, and Webb, with whom Hsieh took courses. All three agreed that Hsieh 'worked hard and [had] done well in all courses' although none of them considered him a man 'of unusual ability'.<sup>31</sup> The request was not approved until late July.

Regardless, Hsieh was determined to study as much as he could while in the U.S. Hence, merely three days after Columbia's Spring Session ended, Hsieh arrived in the University of Chicago on June 14, enrolling in

<sup>28</sup> This was the new Peking University, a predecessor of Yenching, born in 1916 out the union of The North China Union College (Congregational) and the Methodist Peking University. Apparently, Hsieh was initially admitted to the NCUC before 1916 and graduated from the new Peking University in 1917. Edwards, *Yenching University*, 76–7.

<sup>29</sup> It was very likely that Corbett summoned Hsieh, his protégé student, to Yenching in 1921 to help maintain the physics teaching in the department while he was studying at University of Chicago between 1921 and 1922.

<sup>30</sup> 'Hsieh, Yu-Ming', Box 16, Discipline 13: China Medical Board (CMB) Medical Fellowships; Premedical & Miscellaneous Subjects, Chinese, Subgroup 2, RG 10.2, Fellowships, Fellowship Recorder Cards, FA426, Rockefeller Foundation Records, Rockefeller Archive Center, Card #1a. The fellowship includes a stipend of \$90/month, tuition, and necessary traveling expenses for Hsieh himself between China and America.

<sup>31</sup> *Ibid.*, Card #2b.





**Figure 13.2** Y. M. Hsieh at his desk in Yen-ching, Oct. 1926. (Special Collections, Divinity Library, Yale University, The United Board for Christian Higher Education in Asia Records, RG 11, 421-5928, 7251).

three physics courses, one and a half months before learning of the renewal of his Rockefeller fellowship for another year. In Chicago, Hsieh was able to take courses with eminent American physicists and mathematicians such as Albert A. Michelson (the first American physicist to win the Nobel Prize in 1907), Arthur H. Compton (1927 Nobel laureate for physics), Henry G. Gale, L.E. Dickson, and G.A. Bliss in the following Autumn and Winter Quarters. Hsieh apparently greatly enjoyed his study in Chicago. Evidence shows that Hsieh had requested no later than January 1925 CMB's permission to extend his study for another year, even at his own expense,<sup>32</sup> arguing that the time given to his study in America was not sufficient to qualify him 'to carry the type of work which [the CMB] wish[ed] him to do at Yen-ching;' he promised that 'with another year's work he [would] feel thoroughly qualified'.<sup>33</sup> Probably because of Hsieh's request, Corbett inquired of Gale about the former's performance. Gale,

<sup>32</sup> *Ibid.*, Card #3b.

<sup>33</sup> *Ibid.*, Card #3a.

who was then not only Hsieh's teacher and the chairman of the Department of Physics, but also the Dean of the Ogden Graduate School of Science at the University of Chicago, told Corbett in February 1925 that he was 'quite favorably impressed by [Hsieh's] ability', performing 'well above the average of the Chinese students [in Chicago]'.<sup>34</sup> Gale's favorable evaluation of Hsieh must have contributed to the eventual approval of the latter's request. Despite their initial reluctance due to the urgent demand of Hsieh's service at Yenching, the CMB eventually approved Hsieh's request to continue his work at the University of Chicago for the 1925–1926 academic year, but without any additional financial support.

Hsieh spent a total of eight quarters at the University of Chicago, during which he took twenty-four courses, audited three more, and completed English and German exams. It is important to note that Hsieh took several courses in mathematics and theoretical physics, including those on relativity and quantum theory, even though his main research interest was in experimental optics. Since June 1925, he had been working diligently in the Ryerson Physical Laboratory for eleven months on his thesis research, which was closely related to Michelson's work concerning the impact of the Earth's rotation on the velocity of light. A few weeks later, he finished writing his dissertation titled 'The Effective Wave-length in White-light Interferometry'. Having passed the final examination for his doctorate on June 19, Hsieh sailed from San Francisco on August 3, 1926, bound for China. Exactly one month after Hsieh's departure from America, the University of Chicago officially conferred him the Ph.D. degree in physics and mathematics.<sup>35</sup>

With systematic modern physics education and research skills gained in the United States, Dr. Hsieh returned to Yenching in fall 1926, just in time for lectures that semester. This newly promoted Assistant Professor (ranking just below Professor at Yenching) resumed his classroom instructions with two courses, one of which, Advanced Optics, was brand new in Yenching's curriculum but had an identical title to a course he took in Chicago. Obviously, Hsieh was eager to pass on to his students what he had learned in America. Hsieh's return strengthened the department in not only class instructions but also scholarly research, making it possible to create the MS program in the department. As a co-founder of this program, Hsieh shared with Anderson the responsibility of directing and supervising the first two graduate students: Wei and Wu. While Anderson mentored Wei,

<sup>34</sup> On H.G. Gale: <https://www.lib.uchicago.edu/e/scr/findingaids/view.php?eadid=ICU.SPCL.GALE&q=Gale,%20Henry%20Gordon> (accessed on June 25, 2018)

<sup>35</sup> Yenching University College of Natural Sciences, 'Statement Presented to the Rockefeller Foundation,' 50; Yu-Ming Hsieh, Y.M. Hsieh's Matriculation Records at the University of Chicago.

Hsieh advised Wu. Supported by Hsieh and other physicists at Yenching as well as at Peking and Tsinghua universities, Wu completed his MS thesis titled 'The Rectification of Alternating Current by Crystals with Metallic Contact' in June 1929, in which he attempted to clarify the mechanism of rectification by crystals, important devices for contemporary wireless telegraphy and telephony.<sup>36</sup>

Hsieh, who succeeded Anderson to head the department in 1928, was likewise a diligent educator. He taught various undergraduate and graduate courses, including general physics, analytical mechanics, physical optics (or advanced optics), molecular physics and heat (or kinetic theory of gases), modern physics, advanced experiments, modern developments in physics, and an outline of theoretical physics. Apparently inspired also by his experience in the University of Chicago, Hsieh initiated in Fall 1929 the 'Physics Journal Club' at Yenching, which consisted of all instructors, graduate students, and 'senior students' in the physics department. This Club met weekly to review and discuss the current physics literature. Beginning in Fall 1930, the students mentioned above were required to attend the Club regularly.<sup>37</sup>

Under Hsieh's leadership, the department announced publicly in 1929 that nurturing physics researchers was part of its mission. The Yenching Department of Physics was the first in China to set their sights on training physics researchers domestically. According to this departmental mission statement,<sup>38</sup>

<sup>36</sup> Wu concluded in his thesis that 'the rectifying property of certain crystals may be due to capacity effects and electronic movement, or more briefly, it may be due to a 'Tungar-condenser Effect.' See Ching-huan Wu 吳敬寰, 'The Rectification of Alternating Current by Crystals with Metallic Contact' (M.S. Thesis, Yenching University, 1929), 1–2, 49–50. Wu's thesis research was a great example of collaboration between private Christian Yenching University and two other leading national universities in Peking because Peking University loaned Wu 'the e/m apparatus' which allowed him to carry out the first part of the experimental work and it was Pen-Tung Sah (薩本棟), a physics professor at Tsinghua University, who suggested Wu to conduct this experiment.

<sup>37</sup> 褚聖麟 CHU Shenglin and 吳自勤 WU Ziqin, 'Xie Yuming jiaoshou shilue' (A short biography of Yu-ming Hsieh', *Wuli*, 16/3 (1987), 185; *Yenching University Bulletin, Announcement of Courses, 1927–28*), 55; *Announcement of Undergraduate Courses 1928–1929* (note 21), 51; Yenching University Bulletin, *Announcement of Courses, Graduate Division, 1929–30* (Beijing, 1929), 31; *Announcement of Courses, Graduate Division, 1930–31, Yenching University Bulletin*, xii.20 (Beijing, 1930), 39. When Hsieh was at the University of Chicago, there was a 'Physics Club' which was conducted by members of the physics department and met 'regularly for the discussion of the results of research work done in the Ryerson Laboratory and elsewhere'. University of Chicago, *Annual Register, 1922–1923* (Chicago, 1922), 255. The prerequisite for Yenching's 'Physics Journal Club' was two years of courses in physics; students who met that requirement were the so-called 'advanced students' or 'senior students'.

<sup>38</sup> Yenching University College of Natural Sciences, *Announcement of Courses 1929–30* (Beijing, 1929), 44.

The instructional work in physics is directed toward the following ends: (1) the training of premedical and pre-engineering students for professional study; (2) the training of general students in scientific methods of work and in the understanding of the place of physical science in the modern world; (3) the training of teachers of physics; (4) the training of research workers in physics.

Considering the department's historical connections with the PUMC and the contemporary demands of the Chinese society, one can understand why 'the training of research workers in physics' was of relatively low priority. The new mission, nonetheless, prompted the department to recruit William Band, an energetic young British physicist, as the new instructor for theoretical physics that fall.

Hsieh emphasized experimental work and underscored the cultivation of students' practical ability to operate in the laboratory. In 1931, he offered two more new courses. One was 'Advanced Experimental Optics,' taught concurrently with his 'Advanced Optics'. This new experimental course dealt with 'lens systems, prisms, diffraction phenomena due to single slit, double slit, diffraction grating of the concave reflection types, photometer, refractometer, Michelson interferometer, polariscope and polarimeter'. The other was 'The Teaching of Physics' which offered students not only the 'experience in the preparation of laboratory materials, in the conduct of laboratory work under supervision and in helping professors to set up demonstration lectures for General Physics', but also opportunities for 'making and repairing simple physical apparatus'.<sup>39</sup> In 1933–34, Hsieh was scheduled to teach new courses such as 'Atomic Physics', 'Electron Physics', and 'Spectroscopy', but did not return to Yenching from California until the following year.<sup>40</sup>

Hsieh was an accomplished researcher. Collaborating with William V. Houston (1900–1968) at California Institute of Technology (Caltech), Hsieh completed in 1933 some very significant experiments which 'born directly on the worth of quantum field theory in general and the renormalizability of quantum electrodynamics in particular.' Examining the fine structure of the Balmer lines of hydrogen, Houston and Hsieh found a 'large'—about 3 percent—discrepancy between the theoretical prediction and their experimental results. Based on their 'sufficiently accurate' measurements and inspired by J. Robert Oppenheimer's and Niels Bohr's remarks concerning the widespread ignorance of 'the effect of the interaction between the radiation field and the atom' or self-energy in contemporary

<sup>39</sup> Chu and Wu, 'A Short Biography of Yu-ming Hsieh', 185; College of Natural Sciences, 1931–1932, *Yenching University Bulletin*, xvi.25 (Beijing, 1931), 71, 73.

<sup>40</sup> *Announcement of Courses, Graduate Division, 1933–34, Yenching University Bulletin*, xviii.20 (Beijing, 1933), 30–1.

theoretical predictions, they boldly suggested that ‘the theory is no longer satisfactory’ and attributed the discrepancy to ‘the effect of the interaction between the radiation field and the atom [that is, self-energy]’. Houston was the primary investigator in this experiment, who, well versed in theoretical quantum mechanics, likely led the investigation to reach this remarkable conclusion. Unfortunately, the excellent paper of Houston and Hsieh was largely neglected and forgotten for more than a decade until Willis Eugene Lamb (1913–2008) confirmed the same discrepancy with his precise measurement in a newly designed experiment in late 1947. In 1955, Lamb received the Nobel Prize in physics ‘for his discoveries concerning the fine structure of the hydrogen spectrum’. The significant contribution of Houston and Hsieh was not recognized until 1986, when Crease and Mann published their study concerning the intriguing genesis of the famous Lamb Shift.<sup>41</sup>

### **William Band: A ‘Mathematical and Practical’ Physicist from England**

When Hsieh left Beijing in 1932 for Pasadena to work at Caltech, William Band (1906–1993) took over as department chair. Band received his M.Sc. at University of Liverpool (UOL) in 1927, with a master’s thesis titled ‘An Examination of Professor Whitehead’s Theory of Relativity’, which was praised by Arthur S. Eddington. According to Eddington, the M.Sc. thesis ‘fell only [a] little short of the standard’ for an ordinary Ph.D. dissertation

<sup>41</sup> Born in Mount Giliad, Ohio, William V. Houston received a B.A. in physics and a BS in education from Ohio State University (OSU) in 1920. After studying with Michelson, Millikan, and Gale and earning his MS degree at University of Chicago in 1922, Houston returned to OSU and received his Ph.D. in physics in 1925. He was a 1925–27 National Research Fellow, working at Caltech on ‘experimental and theoretical study of spectral fine structure’. As a Guggenheim Fellow, Houston also studied in Germany in 1927–28, working with Sommerfeld and Heisenberg successively. Since 1928, he had been on the faculty of Caltech until becoming the second president of the Rice Institute in 1946. (National Research Council (U.S.), 30. Interview of William V. Houston by Gerald Phillips and W. J. King on 3 March 1964, Niels Bohr Library & Archives, American Institute of Physics, College Park, MD USA, [www.aip.org/history-programs/niels-bohr-library/oral-histories/4682](http://www.aip.org/history-programs/niels-bohr-library/oral-histories/4682); ‘Biographical Note’ in W. V. Houston, ‘Guide to the William V. Houston personal papers, 1925–1968, bulk 1941–1968 MS 426MS 426’, <http://www.lib.utexas.edu/taro/ricewrc/00056/rice-00056.html>.) Robert P. Crease and Charles C. Mann, *The Second Creation: Makers of the Revolution in Twentieth-Century Physics* (New York, 1986), 110–28. The quotes appear in pages 110, 113. ‘Willis E. Lamb - Facts’, Nobelprize.org, Nobel Media AB 2014. Web., [http://www.nobelprize.org/nobel\\_prizes/physics/laureates/1955/lamb-facts.html](http://www.nobelprize.org/nobel_prizes/physics/laureates/1955/lamb-facts.html). Houston as the primary investigator: On Feb. 16, 1933, Hsieh wrote to Rockefeller Foundation, saying that he was doing research under Houston’s guidance. (‘Hsieh, Yu-Ming’, Box 16, RG 10.2, Fellowships, Fellowship Recorder Cards, FA426, Rockefeller Foundation Records, Rockefeller Archive Center, Card #4b.)

in Britain.<sup>42</sup> In 1929, the physics department at Yenching was very happy to hire this 23-year-old teaching assistant at UOL not only because of the shortage of instructing staff in the department after Anderson's departure, but also, or even mostly, because of Band's 'particular qualifications' which 'fit in very well with their needs'.<sup>43</sup> The department needed someone like Band who was able to teach and lead students' research in both theoretical and experimental physics. His thesis on relativity demonstrated his theoretical qualification. Moreover, Band also had substantial working experience in experimental physics. After earning his M.Sc., while serving as a 'Demonstrator' in the physics department at University of Liverpool, he collaborated with A. J. Maddock, a graduate student, in a research on the crystal structure of titanium dioxide (TiO<sub>2</sub>) by means of X-rays under the direction of R.W. Roberts, the Lecturer in the department. According to Roberts, Band and Maddock 'very ably carried out' their research which 'proved invaluable to the development of this subject by subsequent workers in this department'. James Rice, Band's M.Sc. thesis advisor, consequently, stated that when Band left Liverpool for Beijing in 1929, 'he was exceptionally well equipped for his age on the mathematical and practical sides of physical science'.<sup>44</sup>

Band arrived in Yenching at the end of September. His arrival greatly helped the physics department both in coping with the growing student enrollment since the late 1920s and in enhancing its graduate education and research. It is said that the department admitted 20 freshmen in 1931 and maintained a similar annual admission rate in the following few years.<sup>45</sup> The increasing number of Yenching's physics graduates in the 1930s, as shown in Table 13.1, indeed indicates the growing undergraduate and graduate student enrollment since 1927. Yenching's physics enrollment, however, fluctuated over the following decade.

At Yenching, Band was a diligent and popular mentor with broad teaching and research interests. During his eleven-year-residence in Beijing, he taught at least 24 different courses, which covered a wide range of subjects

<sup>42</sup> James Rice, Recommendation Letter, August 14, 1934. Special Collections, Divinity Library, Yale University, The United Board for Christian Higher Education in Asia Records, RG 11, 320-4877.

<sup>43</sup> 'J. B. Tayler to W. Band, Peking, March 14, 1929'. 1929. Records of the Council for World Mission, Box 27, Folder 2073, London Missionary Society Archives at the School of Oriental and African Studies Library, University of London.

<sup>44</sup> R.W. Roberts, Letter, July 10 1934; William Band, *Autobiography*: 班威廉 *William Band*, Archives, and Special Collections, Washington State University Libraries, Pullman; James Rice, Letter, August 14, 1934.

<sup>45</sup> Pan, Wu, and Fan, 'A Draft History of the Physics Department', 494-5. The claimed admission of 20 freshmen in 1931 appears to contradict the fact that the department awarded no BS degree in 1935 (see Table 3) when that group of students were scheduled to graduate. It is hard to believe that all these 20 students would have failed to graduate.



**Figure 13.3** William Band in traditional Chinese dress standing in apparently his residence at Yenching likely soon after his arrival in China. (Cage 617, William Band Papers. Manuscripts, Archives, and Special Collections, Washington State University Libraries, Pullman, WA.)

from elementary ‘college physics’ to advanced ‘relativity theory’ and ‘quantum mechanics’, from experimental ‘premedical laboratory’ to mathematical and theoretical ‘tensor and vector analysis’ and ‘statistical mechanics’, and from practical and specialized ‘meteorological physics’ and ‘thermodynamic effect’ to metaphysical ‘natural philosophy of modern physics’.

It was particularly remarkable for Band, a 24-year-old instructor of theoretical physics, to commence ‘The Natural Philosophy of Modern Physics’ at Yenching, which must have been the first college course of its kind in China. This seminar began with a summary of the theories of relativity, wave mechanics of the atom, and statistical mechanics and then explored the natural philosophy of Alfred N. Whitehead, Charlie D. Broad, Bertrand Russell, and Arthur Eddington. Band intended to give students in various disciplines ‘a grasp of the significance of [modern physics]’. By design, this course was not ‘exactly elementary in nature’. Although Band attempted to keep its physics content ‘as non-technical as possible’, there



Table 13.1 Yenching physics graduates (BS & MS), 1929–1941<sup>1</sup>

	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	Total
BS	2	1	6	5	3	4	0	6	9	6	8	4	11	65
MS	2	0	2	2	2	8	2	3	2	2	0	6	2	33

<sup>1</sup> This table is a result of this author's examination of existing theses of Yenching's physics department deposited in Peking University Library in Beijing, China as well as 燕大理学院 [School of Natural Sciences at Yenching University]; The Department of Physics and the Physics Club of Yenching University, 22–24.

remained 'sufficient difficulty' 'in understanding the philosophical part of the subject'. Band therefore restricted the participants of his seminar to 'mature' or graduate students, who he had personally approved.<sup>46</sup> The seminar was apparently so successful that Band offered it in three consecutive years and a total of four times before 1935. In fact, it attracted not only advanced students but also some professors from other departments. For instance, Dr. Randolph C. Sailer of the Department of Psychology and Dr. Lechung Tsetung HWANG (or HUANG Zitong 黃子通) of the Department of Philosophy attended the seminar. Both of them, according to Band, offered 'many helpful suggestions' and had 'thought-provoking discussions' with the young instructor.<sup>47</sup> Probably partially inspired by the seminar and his discussions with Band, Hwang, then a full professor and the chairman of the philosophy department, later published an essay about Whitehead's theory of space-time.<sup>48</sup>

Between 1930 and 1941, Band also supervised 26 BS and 22 MS theses, which represented respectively 42% and 73% of the total number of relevant degrees the department awarded during that same period. Most of these theses dealt with experimental subjects. Of the total of 48 theses, only seven (14.6%) were theoretical treatises. This demonstrates a peculiar situation in the contemporary development of modern theoretical physics in China.

As a theoretical physicist working in Beijing, Band soon became keenly aware of peculiar local challenges. In his 1933 essay 'Modern Theoretical Physics in China', he discussed the value of theoretical physics in the

<sup>46</sup> *Announcement of Courses, Graduate Division, 1930–31, Yenching University Bulletin*, xii.20 (Beijing, 1930), 39.

<sup>47</sup> William Band, *The Philosophy of Modern Physics* (unpublished manuscript: Washington State University Libraries, Manuscripts, Archives, and Special Collections, Pullman, WA, 1931), 'Foreword'. Band spelled Hwang's name as 'L.T. Huang'.

<sup>48</sup> *Yenjing daxue jiaozhiyuan xuesheng minglu* (Yenching University Directory), 1930–1931 (Beijing, 1930), 5; Lechung Tsetung HWANG 黃子通, 'Huaiheide de shikong guan (Whitehead's view of space-time)', *Zhexue pinglun* (The philosophical review) 6/1 (1935). Hwang was an uncle of Kun HUANG, a famous Chinese physicist, who earned his BS at Yenching in 1941 under Band's direction.

country, the status of the subject in Chinese universities, and the possible ways of improving its instruction in colleges. Band recognized that theoretical physics was then 'one of the most vulnerable to the common criticisms of university enterprises in China' because it 'appear[ed] to be the least connected with the needs of the nation; and advanced work in the subject the least useful of all research'. He admitted that as a subject of research, theoretical physics was actually 'a hobby' instead of 'a vocation' in China and hence had 'a subordinate place in the [university] curriculum'. Nevertheless, he valued the subject as efficient 'mental gymnastics' and for 'its inherent stimulating interest'. More importantly, he argued that the advanced work in theoretical physics could keep China '[in] touch with the progress in other countries' and help 'maintain her position in the world of Science'. After all, Band believed, 'China cannot afford to be always training her progressive physicists abroad!' In conclusion, he observed,

[T]heoretical physics has not yet come to its own in this country. Probably the natural emphasis on technical science will delay the otherwise inevitable process of growth for some time, but already sufficient original work has been done by Chinese physicists to prove that eventually their breed will be as prolific in theoretical research as the western variety.<sup>49</sup>

By 1934, Band had realized from his experience that many Chinese students had 'a considerable natural aptitude for theoretical work', but there was practically no place in China where they could receive adequate training in theoretical physics. Band therefore planned to spend his prospective 1935–1936 sabbatical leave engaging in advanced theoretical studies at Harvard University 'in order to bring back to Yenching a better stimulus for more complete and proportionate development therein'. Being chiefly interested 'in the philosophical basis of modern theoretical physics', Band wished to set up a 'joint major' where students would study and benefit from both physics and philosophy.<sup>50</sup>

In pursuit of this objective, Band applied for a fellowship from the Rockefeller Foundation, but failed to win one, most likely due to unfortunate timing. It was evident that the Foundation had by then changed its policy on the fellowships in China: no more were being offered

<sup>49</sup> William Band, 'Modern Theoretical Physics in China', *Lingnan Science Journal* 12 (1933), 105–10.

<sup>50</sup> To The Rockefeller Foundation: Application for Fellowship for Advanced Study in Physics at Harvard University, Cambridge, Massachusetts, ca. December 1934. Special Collections, Divinity Library, Yale University, The United Board for Christian Higher Education in Asia Records, RG 11, 320-4877.

for pure sciences.<sup>51</sup> As a result, Band was forced to postpone his sabbatical and left for Cambridge University instead of Harvard in 1936–37, where he studied with Ralph Fowler, Arthur Eddington, Paul Dirac, and Rudolf Peierls. Apparently, Fowler was most influential on Band's later teaching and study: he not only added a new course 'Statistical Mechanics' to Yenching's curriculum but also supervised four theoretical theses in statistical physics, all completed between 1940 and 1941. His popular textbook *An Introduction to Quantum Statistics* was first drafted at Yenching after 1936.<sup>52</sup>

Band never fulfilled his wish to establish a study center for theoretical physics, as the Japanese occupied Beijing and launched the full-scale invasion of China in July 1937. By the late August of 1937 when Band returned to Yenching, many of its faculty and students had already departed Beijing, including both Hsieh and Meng, which left the department with no faculty ranking at either Full Professor or Lecturer. As the head and the sole remaining Assistant Professor in the department during 1937–38 and the only Full Professor afterwards, Band was forced to spend most of his energy and time maintaining the department's normal operation; there was little chance for him to prepare and launch a new program for theoretical physics before he had to flee from Beijing himself at the end of 1941.

Despite the shortage of senior faculty and other hardship in the aftermath of the Japanese occupation of Beijing, Band managed to keep the department running with normal or even above-average productivity in the following four years, as shown in Table 13.2. After returning to China from England, Band supervised at least six students through to the completion of their theses in theoretical physics. By 1940, Yenching's physics department excelled at nurturing researchers who were able to carry out original studies, in contrast with its counterparts in the country. When the Chinese Physical Society convened its 8<sup>th</sup> annual meeting in Kunming in September 1940, a total of forty papers were presented, of which Yenching's faculty and students submitted twelve (30%) and Band co-authored five—almost half of the contributions from Yenching.<sup>53</sup>

<sup>51</sup> Gunn to Hanson, March 19, 1935, Folder 349, Box 42, Series 601E, RG 1.1, Projects, FA386, Rockefeller Foundation records, Rockefeller Archive Center; Gunn to Mason, August 28, 1935, Folder 349, Box 42, Series 601E, RG 1.1, Projects, FA386, Rockefeller Foundation records, Rockefeller Archive Center.

<sup>52</sup> William Band, *An Introduction To Quantum Statistics* (Princeton, 1955); William Band, 'William Band: Interview by George E. Duvall and James L. Park, April 25, 1985', transcript, Archives 202 Box 1, WSU Centennial Oral History Project, Manuscripts, Archives, and Special Collections, Washington State University Libraries, Pullman, WA, 11–12.

<sup>53</sup> The Department of Physics and the Physics Club of Yenching University, 'The Eighth Annual Meeting of the Chinese Physical Society', *Wuli xuexun* (Physics News), 8 (1940), 21; *Zhongguo wuli xuehui liushi nian* (The sixty years of the Chinese Physical Society) (Changsha, 1992), 7.

### **An Outstanding Cradle of Physics Researchers in China**

Within about two decades, the department of physics at Yenching grew from a premedical training center to a prominent cradle of Chinese researchers in the field. The continuous successful development of research programs in Yenching's Department of Physics was due above all to the enlightened leadership of the first four department chairmen and their devotion. Corbett, an American missionary with much passion for but limited scientific training in physics, founded the department. He clearly realized the importance of advancing professional work in the department even though he had no desire to become a professional physicist himself. Hence, he recruited Anderson, a promising young researcher from Harvard, and actively supported Hsieh's graduate study in the United States. Anderson initiated and stressed original research among the students and faculty, both adding a thesis requirement to the Bachelor's degree and launching the first MS program in physics in China. Hsieh actively promoted original experimental researches which often addressed local practical issues in Chinese society. Under Hsieh's leadership, 'the training of research workers in physics' became part of the department's mission in 1929. He also strengthened the theoretical study in the department by recruiting William Band. Band chaired the department between 1932 and 1941 and supervised most of the MS theses in the department. In fact, he probably directed more MS students in physics than anyone else in Republican China. He provided one of the most comprehensive sets of courses in advanced theoretical physics at Yenching and supervised the first master thesis in modern theoretical physics in the country.<sup>54</sup> It is also important to note that Anderson, Hsieh, and Band were all active and accomplished researchers themselves.

The abundant funding and profound educational connections with Western institutions also contributed greatly to the department's success. As noted in the earlier discussions, the Rockefeller Foundation was the leading sponsor for the department. The Foundation handed over the entire Premedical School of the PUMC together with its library and lab equipment to Yenching in 1925 and funded the advanced training of the department's leading faculty such as Corbett, Hsieh, Yang, and Meng. It also sponsored Anderson's and Band's stay at Yenching. Most of these

<sup>54</sup> Band, 'Modern Theoretical Physics in China', 106. Since Band stated that he did not find in 1933 'any master theses written on theoretical topics', H.Y. Hsu's 1934 thesis 'Relativity and Wave Mechanics' became likely the first MS thesis in China concerning modern theoretical physics. (C. C. Wang 王竹溪 at Tsinghua University published a theoretical paper titled 'Turbulent Wake behind a Body of Revolution' also in 1934, but it is not on modern physics.)

faculty and many of their students studied at American universities like Columbia, the University of Chicago, the University of Michigan, Caltech, or Harvard. All these contributions from the Foundation represent only a small part of the deep and widespread American influence on contemporary scientific development in China. The department's connections with its counterparts in Britain also helped create opportunities for its students to receive advanced training there. W. Y. Chang and Y. K. Hsü, two of Band's graduate students, for example, did research with Ernest Rutherford at the University of Cambridge and James Chadwick at the University of Liverpool, respectively.

One of the striking features of Yenching's physics study was its intensive attention to local or practical issues. Of forty-three BS and MS theses completed between 1930 and 1936, twenty (47%) dealt with local or practical problems. Several factors must have contributed to this trait. First, with its motto 'Freedom through Truth for Service,' Yenching actively encouraged its faculty and students to use their knowledge to conscientiously serve local society. Second, Y.M. Hsieh was a believer in John Dewey's pragmatist philosophy in scientific education. Third, the early 1930s coincided with the Rural Reconstruction Movement (RRM) which aimed at reconstructing rural culture, economy, health, and political awareness through education. Both Hsieh and Band clearly shared the ideals of the RRM and were enthusiastic in leading their students to participate in it. Fourth, since the Rockefeller Foundation, a main funding source for Yenching, had turned their attention away from pure sciences to 'practical fields' such as the RRM, it was also necessary for Yenching to take corresponding measures to accommodate its sponsor.

Another outstanding trait of Yenching's physics department was that it nurtured more female physics researchers than any of its contemporary counterparts in China. Yenching awarded a BS to its first female graduate in physics, WANG Ming-chen (hereafter M.C. Wang) as early as 1930. By Fall 1937, at least seven female students had earned their BS degrees at Yenching and two of them, M.C. Wang and WANG Cheng-shu (hereafter C.S. Wang) went on to earn their MS degrees.<sup>55</sup> In contrast, Tsinghua University, the most prestigious national university in the country, produced no female BS in physics until 1936. Merely four women graduated from Tsinghua's physics department before fall 1937, three in 1936 and one in 1937; no woman was ever admitted to that department's graduate

<sup>55</sup> C.S. Wang was known in the West as C.S. Wang Chang because she married W.Y. Chang, another prominent graduate from Yenching, who earned his BS and MS under Band's supervision in 1931 and 1932 respectively.

program before 1937.<sup>56</sup> At least three of the female graduates from Yenching went on to earn their doctorates at the University of Michigan, among whom were M.C. Wang and C.S. Wang, who studied and later collaborated with George Uhlenbeck, making significant contributions to statistical physics.<sup>57</sup>

Indeed, what Yenching's physics department had accomplished was even more striking if we compare it with its counterparts in China. By 1937, there had been established more than 30 college departments of physics in China,<sup>58</sup> of which only Yenching, Tsinghua, and Peking universities set up their MS program in physics before 1936.<sup>59</sup> It is therefore enlightening to juxtapose these three.

Peking, Tsinghua, and Yenching universities were all in the city of Beijing; while Peking University was situated in the city center, the other two were located in a northwest suburb neighboring each other. In the 1930s, the physics departments in these three schools all imitated their counterparts in America. After all, most of their leading faculty were trained in the United States and their daily work was mainly funded by either the refunded part of the American share of the Boxer Indemnity or private American sponsors such as the Rockefeller Foundation.<sup>60</sup> As shown in Table 13.2, Peking University, the oldest national university in the country, was the first to establish a physics department in 1913 and had produced more college graduates (BS) than the combined total number of BS from both Tsinghua

<sup>56</sup> For a complete list of college graduate (BS) in physics from Tsinghua University, see Qinghua daxue xiaoshi yanjiushi (Office for the study of Qinghua University history), *Qinghua daxue shiliao xuanbian* (Selected historical documents of Tsinghua University), 4 vols. (Beijing, 1991), ii.2, 784, 792, 799, 808, 819–20, 825–6, 833, 843–4, 856–7. According to HU Shenghua, there were only nine men earned their Master's degree in physics at Tsinghua before 1947 (adding J.S. Wang who Hu apparently missed). See HU Shenghua 胡升華, 'Ershi shiji shangbanye zhongguo wulixue shi' (A history of Chinese physics during the first half of the 20th century) (Dissertation, Chinese University of Science and Technology, Hefei, China, 1998), 63.

<sup>57</sup> Danian Hu, 'American Influence on Chinese Physics Study in the Early Twentieth Century', *Physics in Perspective* 17/4 (2016), 284–7; M. C. Wang and G. E. Uhlenbeck, 'On the Theory of the Brownian Motion-II', *Reviews of Modern Physics* 17/2-3 (1945); C. S. Wang Chang and G. E. Uhlenbeck, *Transport Phenomena in Polyatomic Molecules* (Ann Arbor, 1951); 'On the Propagation Sound in Monatomic Gases', in *Studies in Statistical Mechanics* (Amsterdam, 1970).

<sup>58</sup> LUO Bingxian 駱丙賢 (ed.), *Wuli jiaoyu shi* (A history of physics education) (Changsha, 2001), 138.

<sup>59</sup> SHEN Keqi 沈克琦 and ZHAO Kaihua 趙凱華 (eds.), *Beida wuli beinian* (Centenary of Physics at Peking University, Unofficial publication (Beijing, 2013), 20; Hu, 'A History of Chinese Physics' (note 53), 73. SUN Hong'an 孫宏安, *Zhongguo jinxiandai kexue jiaoyu shi* (A history of modern science education in China) (Shenyang: 2006), 476.

<sup>60</sup> For the history of the physics departments at Peking and Tsinghua, see Shen and Zhao, *Centenary of Physics at Peking University* (note 57), 17–32; HU Shenghua, 'History of Chinese Physics,' 60–78. For a discussion about the American refund of the Boxer Indemnity, see Danian Hu, 'American Influence on Chinese Physics Study', 275–7.

Table 13.2 The Physics Departments at Peking, Tsinghua, and Yenching before 1937<sup>1</sup>

Name of University	Start of the University	Start of the Department	First BS Graduate	Start of MS Program	First MS Graduate		Senior Faculty in the 1930s	
					BS	MS	BS	MS
Peking	1898	1913	1916	1935	None	221	0	7
Tsinghua	1925	1926	1929	1929	1933	53	2	7
Yenching	1918	ca. 1918	1922	1927	1929	43	22	3

<sup>1</sup> The data on Peking and Tsinghua universities were drawn respectively from Shen Keqi 沈克琦 and 赵凯华, 17–30; Hu Shenghua 胡升华, 60–78; Qing hua da xue. Xiao shi yan jiu shi 清华大学校史研究室, 2 (Part II), 561, 646–647, 784, 792, 799, 808, 819–820, 825–826, 833, 843–844, 856–857.

and Yenching before 1937. However, Yenching was the first to set up a master of science program in physics in 1927. Both Peking and Tsinghua had more than twice as many senior faculty members as Yenching did, and yet it was Yenching that nurtured most MS in physics, i.e. physics researchers, domestically, far more than the other two prestigious national universities did.

It should be added that Yenching produced an additional 10 MS graduates before it was shut down by the Japanese in 1941; Tsinghua eventually awarded another 7 MS degrees, including the two earned by Chen-Ning YANG 楊振寧 and Shou-lien CHANG 張守廉, during 1937–1949 while Peking gave out at least one to Kun HUANG 黃昆. It is remarkable that Chang transferred from Yenching to the National Southwest Associate University (NSAU) in Kunming and Huang graduated from Yenching (BS, 1941).

More than a dozen graduates from Yenching's physics department had gone on to earn their doctorates overseas (mostly in America) and grown into prominent physics researchers in China and in their own field. Among these distinguished graduates, eight were late elected CAS Academicians and two were awarded the State Preeminent Science and Technology Award, the highest scientific award issued in the country. Despite its small size, this department became an indispensable cradle that successfully nurtured many excellent researchers for China. Such a great contribution from an American missionary university is remarkable, and certainly worthy of note.

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