

Chapter 1

Family and Education



1 His Father Qian Junfu

“My father was my first teacher,” Qian Xuesen said seventy years later for the *People’s Daily*, a major Beijing newspaper. “He opened a new world for me in art, music and literature.” Qian Junfu is gradually known to the public as Qian Xuesen’s father only after Qian Xuesen passed away. In fact, Qian Junfu had led a colorful and legendary life, and had contributed much to the country’s education.

The descendant of Qian Lineage in Wuyue

On December 26, 1882 (the seventeenth of November on the Lunar Calendar, the 8th year of Guangxu Emperor), Qian Junfu was born in the Qian lineage’s old residence in Eastern Street, Renhe County, Hangzhou City, Zhejiang Province. Qian’s lineage can be traced back to King Qian Liu of the Kingdom of Wuyue (852–932), of whom Qian Junfu was the 32nd descendant. The Wuyue Qian lineage had been prosperous since Qian Liu established the Kingdom of Wuyue. Qian Jizu, Qian Junfu’s grandfather, run silk business in Eastern Street of Renhe County and was quite wealthy. Qian Jizu had four sons, with Qian Chengrong the eldest son, Qian Chengzi the second and Qian Chengduo the third, while the youngest son was adopted by the Lu lineage, the lineage on the part of Qian Jizu’s wife and thus changed his surname to Lu.

Qian Chengzi had two sons, the elder son Qian Jiarun (courtesy name, Zefu) and the younger son Qian Jiazhi (courtesy name, Junfu). Qian Jiarun’s son, Qian Xuequ, was admitted to the Department of Aeronautical Engineering of Massachusetts Institute of Technology as a Boxer Rebellion Scholarship recipient administered through Tsinghua University after he graduated from the School of Mechanical Engineering at Jiaotong University. He was a well-known expert in the aviation field in the United States. Qian Xuequ and his wife, Li Yiyang had three sons. The eldest son Qian Yongyou is a member of the U.S. National Academy of Sciences; the second son Qian Yongle is a computer scientist and the youngest son Qian Yongjian was a 2008 Nobel Prize winner in chemistry. Qian Junfu and Zhang Lanjuan had a son,

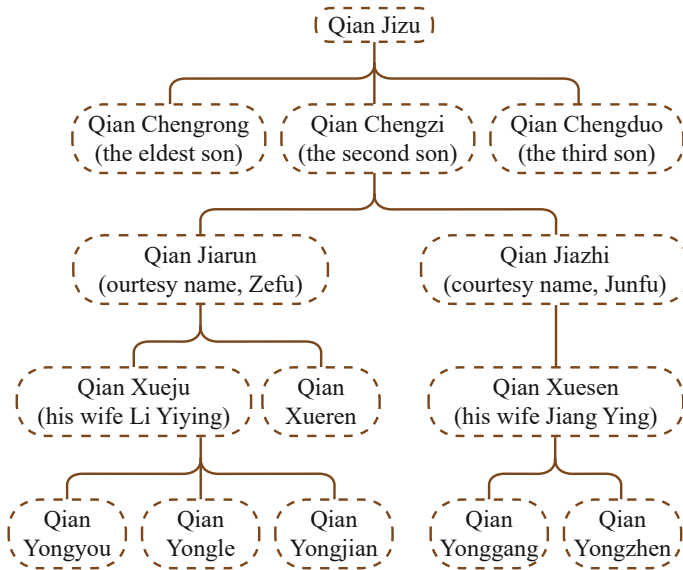


Fig. 1 Qian Junfu's family pedigree

who unfortunately died young. Later on, the couple had another son, Qian Xuesen (Fig. 1).

Receiving both traditional and modern education

Qian Junfu was born in the transitional stage of Chinese society, from traditional to modern, so his life was deeply marked by the times. He had the opportunity to receive both traditional and modern education. In the traditional Chinese class stratification of “scholar, farmer, industrialist and businessmen”, scholar had the highest social status. This traditional concept was deeply rooted in Qian Junfu's grandfather Qian Jizu, who expected that his children would become scholars and officials.

Although the family's economic situation was declining when Qian Junfu was born, his father Qian Chengzi spared no effort in supporting his education. In 1888, Qian Junfu, at six, was sent to *si shu*, an old-style private school, and started to learn Chinese primers such as *Thousand Character Text*, *Three Character Classic*, *A Hundred Family Names*, and *Poetry of a Prodigy*. Unable to pay the tuition fees for a private school later on, Qian Junfu was sent to a free school in 1895. In 1898, he left for Shanghai and entered the Wang Yucai School, the predecessor of Shanghai Nanyang Middle School, with financial support from his relatives and friends.

In 1899, Qian Junfu was admitted to Qiushi shuyuan—then a middle school in Hangzhou and later the predecessor of Zhejiang University. During this period, he often discussed with his classmates on how to save the country and participated in the establishment of *Hangzhou Vernacular Newspaper* to promote vernacular Chinese. He gradually realized the importance of education in national rejuvenation and survival, and was determined to save the country through education [1].

In September 1902, Qian Junfu joined a group of government-funded students, Zhou Chengpeng, Shi Yuruo, Han Qiangshi, Zhang Futing, Han Shutao, Shen Qifang, Xu Shoushang and Shou Changtian, travelling to Japan to study [2]. Upon their arrival in Japan, they were enrolled in Zhejiang class in the general department of Tokyo Hongwen College. Zhou Shuren from Shaoxing, Zhejiang Province, who was to become China's most famous short story writer under the pseudonym Lu Xun, had arrived in Japan earlier. Although he was from Zhejiang Province, he was arranged in Jiangnan class because he was sent to study on Jiangnan official expenses. During this time, Qian Junfu and Zhou Shuren met and befriended each other and later became close friends. Tokyo Hongwen College was a language school with three academic years. From September 1902 to March 1904, Qian Junfu finished the required courses and graduated earlier in July of 1904. He was then admitted to Tokyo Higher Normal School, the predecessor of Tsukuba University. Tokyo Higher Normal School was a modern college specialized in training teacher trainees. The school was divided into four departments, and Qian Junfu was enrolled in the second department (geography and history department) with duration of four years [3]. In the first year, the students attended the preparatory course, followed by three years for the undergraduate course. In the fourth year, students would participate in field teaching at the school affiliated with the college.

Qian Junfu was hard-working and persevering student and he read widely. He often participated in various social activities organized by foreign students, through which he was acquainted with Li Shutong, a famous modern poet, calligrapher, seal cutter, educator in music and art and dramatist. In 1907, Qian Junfu, together with other Chinese students such as Xu Shouchang, Zhou Shuren, Zhou Zuoren, Gong Baoquan, Zhu Xizu and so on, organized the "Students' Revival Society" in Tokyo [4, 5] (Fig. 2).

In the spring of 1908, Qian Junfu graduated from Tokyo Higher Normal School. After his graduation, he decided to spend half a year in investigating the situation of Japanese education as he thought that one could hardly gain rich experiences simply through learning book knowledge. Xu Shoushang, who graduated at the same time and needed to study German in preparation for his stay in Germany, rented No. 7 Lǔzhi in Nishikata-cho, Hongo, Tokyo for 35 *yen* each month and invited Qian Junfu, Zhu Mouxuan, Zhou Shuren and Zhou Zuoren to live with him and share the rental. Xu Shoushang wrote a sign of "Wushe", meaning five people living there together, on the electric pole near the door. During the period of living at "Wushe", they became disciples of Zhang Taiyan, who had exerted great influence on them.

In 1906, Zhang Taiyan was invited by Sun Yat-sen to Japan and joined Tong Meng Hui, the Chinese Revolutionary League, serving as the editor-in-chief and publisher of *Min Bao Newspaper*, the official journal of the Tong Meng Hui. In 1908, Zhang Taiyan lectured on *Shuowen*, *Zhuangzi*, and *Chu Ci* and other Chinese classics in one classroom of Tokyo Dacheng Middle School, which made him very influential among overseas students. The four residents in "Wushe", namely, Qian Junfu, Xu Shouchang, Zhou Shuren and Zhou Zuoren attended Zhang's lectures. As their school schedule was in conflict with the lecture arrangement, they expressed their wish that additional lectures could be delivered on Sunday mornings to Gong Weisheng, Zhang



Fig. 2 A photo of Qian Junfu when he studied in Japan

Taiyan's son-in-law. Zhang Taiyan agreed to their request and lectures were arranged at the office of *Min Bao Newspaper*, also Zhang Taiyan's apartment.

At the office of *Min Bao Newspaper*, there were eight seats around a low table in the center of the room. Zhang Taiyan sat on one side, with his legs crossed, while eight students on the other three sides of the table. Zhou Zuoren commented: "Taiyan usually had no patience with the rich, but he was very kind to the young students. He talked and laughed casually, treating us as family and friends. In summer days, he sat crossed-legged, bare-chested and wore only a long undershirt. With a little loach beard, he looked like a Buddhist Bodhisattva in a temple" [6].

While Qian Junfu was investigating the situation of education in Japan and attending Zhang Taiyan's lectures, Wang Tingyang was sent to Japan by Zhejiang

Provincial government to Japan to investigate the school affairs. He discussed with Qian Junfu, Jing Hengyi, Xu Shoushang, Zhang Bonghua and other students about running a two-level teacher training school in Zhejiang, and invited them to teach at the school after they return to Zhejiang Province. Qian Junfu thus ended his seven-year study in Japan in the winter of 1908 and returned to his hometown to teach, practicing his early idea of education for national salvation.

A practitioner of saving the nation through education

At the beginning of 1909, Qian Junfu went to teach at the Two-level Teacher Training school in Zhejiang. He taught two courses: foreign geography and foreign history for students in the superior level, and he also taught logic. Soon after, as Jing Hengyi resigned from his position as the provost, Qian Junfu took the provost position temporarily, and he taught two additional course: educational theory and history of education.

Qian Junfu was quite busy when he started teaching. Moreover, since there was no uniform textbook in teacher training schools at that time, teaching materials were generally prepared by teachers according to the content of the curriculum. Qian Junfu collected materials extensively and compiled four textbooks: *Nomenclature*, *General Theory of Geography*, *Foreign Geography* and *Western History*.

In 1905 (the thirty-first year of Guangxu), when the Qing government abolished the imperial examination system, studying abroad became the choice of many intellectuals and the number of overseas students kept expanding. After returning from Japan in the winter of 1908, Qian Junfu took the examination organized by the Ministry of Education of the Qing Dynasty in 1909. In fact, after his return to China, Qian Junfu had no intention to achieve fame and fortune, or to be engaged in politics. When he was teaching at the Two-level Teacher Training School in Zhejiang, he participated in the famous “Papaya Battle” with Lu Xun and 25 others, opposing the dawdling of the old guard supervisor Xia Zhenwu.

In 1909 (the first year of Xuantong), the Qing government introduced the examination method for international students, stipulating that all international students must come to Beijing to take the examination. A total of 383 overseas students, including Qian Junfu, had to register for the examination. Qian Junfu’s examination results were classified as “excellent” and rewarded to “Juren of the liberal arts” (the liberal arts scholar). Subsequently, Qian Junfu went to Beijing in April 1910 to take the court examination and scored seventy points, which was classified as the second grade. After the court examination, Qian Junfu was appointed to the Cabinet of the Chinese Secretary, responsible for writing, recording, translating works in the imperial court, and was entitled to be promoted to the governor of Zhili Prefecture, or be sent to the military bureau after a certain years. However, he did not stay in the capital to seek a job, but returned to Zhejiang as deputy head of the general section of the Public School of Learning. In June 1911, he was appointed as the principal of the First Secondary School in Zhejiang Province.

On January 4, 1914, Wang Daxie, the chief education officer of the Beijing government, petitioned Yuan Shikai, the President, to appoint a group of officials in the

Ministry of Education. Xu Shixiong was the secretary, Qian Jiazhi, Zhang Zongxiang, Wang Xiaojie, Wang Senbao, Wang Jiaju, Bai Zhenmin, and Qi Zongyi were the inspectors, and Fan Hongtai was the commander [7]. Qian Jiazhi was Qian Junfu. He accepted the appointment and went to the Ministry of Education in Beijing to serve as an inspector. After his appointment, Qian Junfu was awarded the title of “Senior Scholar” by the President on July 23, 1915 [8], and was honored by the Premier of the State Council and the Chief Education Officer on March 12, 1917, for his dedication to his duties and conduct. On October 3, 1917, General Education Minister Fan Yuanlian signed a decree appointing the inspector Qian Jiazhi as the head of the third section of the General Education Department of the Ministry [9].

After Qian Junfu became the section chief, he still served as an inspector, but only participated in temporary inspections. During his tenure as section chief, Qian Junfu actively participated in and promoted the Mandarin Movement. The Mandarin Movement aimed to promote the unification of the national language and advocated the “unification of the spoken and written language” and the “unification of the national language”, that was, the establishment of a unified official language.

In April 1927, after the establishment of the Nanjing National Government, the central government organs, including the Ministry of Education, were moved to Nanjing. In the following year, Qian Junfu was appointed by Ma Yinchu, the Undersecretary of the Ministry of Education, as a first class officer in the Department of General Education. From 1928 to 1929, Qian Xuesen was in his third year of high school affiliated to Beijing Normal University, and he was preparing for the university entrance examination. Considering the impact of moving and transferring to another school, Qian Junfu went to Nanjing to take up his post, leaving Qian Xuesen in Beijing under the care of his mother Zhang Lanjuan. In 1929, Qian Junfu was recalled back to Zhejiang Province to serve as the supervisor of the Department of Education after serving in Nanjing for less than a year. Qian Xuesen was admitted to Jiaotong University in the same year, and in the autumn of that year, the family returned to Hangzhou.

On March 6, 1931, the President of the Zhejiang Provincial Government, Zhang Nanxian, requested the National Government to issue an order appointing Qian Junfu as the secretary of the Department of Education of Zhejiang Province. The secretary of the Department of Education was not only responsible for “reviewing communications”, “preparing and keeping important documents” and “reviewing documents of various departments”, but also presiding over “departmental meetings.” This was because the then director of the Department of Education of Zhejiang Province, Chen Bulei, was stationed in Nanjing to perform his duties as the Undersecretary of the Ministry of Education. Therefore, the affairs of the Department of Education were represented by Qian Junfu.

Retired life

The year 1934 was particularly memorable for Qian Junfu with the occurrence of two events. The joyful one was that Qian Xuesen was admitted to Tsinghua University as Boxer Rebellion Scholarship recipient to study in the United States. The other was heartbroken. Qian Xuesen’s mother, Zhang Lanjuan passed away because of

severe typhoid fever. This was undoubtedly a heavy blow to both father and son. Too hard to accept his wife's death, Qian Junfu had been depressed for a long time, which caused him serious stomach disease. When message of his mother's illness came, Qian Xuesen was participating professional internships arranged by Tsinghua University at Jianqiao Aircraft Manufacturing Plant in Hangzhou. After learning the news of his mother's critical illness, he wept and immediately took leave from Tsinghua University to go home so that he could see his mother one last time.

At the time of Zhang Lanjuan's death, Qian Junfu was fifty-two years old and in the right age for his career. However, his stomach illness failed him to work further in his post at Department of Education. He resigned on December 22, 1934, and had rested at his residence located at No. 2, Fangguyuan, Hangzhou. On August 20, 1935, Qian Xuesen boarded on steamship *President Jackson* embarking at Shanghai port to the United States. Qian Junfu sent his son off and lived alone since then. Many relatives and friends persuaded him to remarry, but he declined. After a period of adjustment, Qian Junfu gradually came out of the sadness of losing his wife. Since then, although he had resigned from his official position in the Department of Education, he still enthusiastically participated in the local culture and education, making contributions in his capacity.

Qian Junfu could have spent the rest of his life in Hangzhou, but the July 7 Incident that happened soon after changed the course of his life. After a long period of planning, Japan entered Wanping City in 1937 on the pretext of searching for missing Japanese soldiers, and waited for the opportunity to launch the Lugou Bridge Incident, which shocked China and abroad and opened the prelude to a full-scale invasion of China. Soon after, the Japanese began to bomb Hangzhou, and landed in Hangzhou Bay on November 5, occupying Hangzhou.

At that time, there were many intellectuals in Hangzhou who had studied in Japan. After the Japanese occupied Hangzhou, they decided to organize these people to manage the municipal order, and drew up a list, in which Qian Junfu was in. When Qian Junfu heard that his name was on the list on November 11, he went to the town of Heshangdian in the outskirts of Hangzhou to escape the chaos. Since he could not return to Hangzhou in the short term, and his house at Fangguyuan No. 2 was hit by an incendiary bomb dropped by the Japanese during an air raid, in February 1938, Qian Junfu decided to leave Hangzhou and go to Shanghai for refuge.

After Qian Junfu arrived in Shanghai, he stayed at his wife's brother Zhang Leshan's house at No. 111, Qishan Village, Lane 1032, Yuyuan Road, located in public concession. This was a single bay, 3-storied conjoined villa, the property rights of which originally owned by Zhang Leshan, who still lived on the second floor in the form of rent return after selling it for some reason. When Qian Junfu first arrived in Shanghai, he lived on the second floor in Zhang's house, paying regular rent, meals and utilities until November 1943, when he rented the first floor. The first floor had an area of about 40 square meters and was divided into a living room and two bedrooms, as well as a kitchen and a bathroom. At that time, Qian Xuesen was studying in the United States, and Qian Junfu's daily life was taken care of by his goddaughter Qian Yuehua. Qian Xuesen had lived here for about two months when he returned to visit his family in 1947.

In May 1956, Qian Junfu went to live with Qian Xuesen in Beijing. Qian Junfu's later years in Beijing were undoubtedly happy and gratifying. He was often visited by his son and daughter-in-law with two grandchildren, Qian Yonggang and Qian Yongzhen. As Qian Junfu had worked in Beijing for nearly fifteen years, he had many old friends and they often walked around and chatted to catch up with each other.

On August 23, 1969, Qian Junfu died at the age of 87 due to a stomach hemorrhage, and on September 2, the Central Research Institute of Culture and History held a farewell party for Qian Junfu at Babaoshan Revolutionary Cemetery. In his later years, Qian Xuesen placed two framed items in his bedroom, one of which was a portrait of Qian Junfu, which showed Qian Xuesen's endless memory of his father.

2 His Mother Zhang Lanjuan

“My mother Zhang Lanjuan was the eldest daughter of a rich merchant in Hangzhou, and it was said that my maternal grandfather chose my father as his son-in-law because of his talent,” recalled Qian Xuesen.

Daughter of an affluent family

Zhang Lanjuan was born into an affluent family in 1887 and died of typhoid fever at 47 in 1934. Her father, Zhang Zhenzi, served as a salt official in Guangdong and Guangxi provinces for several years. After leaving his post, Zhang Zhenzi started his businesses in salt, silk and soy sauce in Hangzhou and accumulated solid assets which enabled him to purchase properties in Hangzhou, Shanghai and other places. The two former residences of Qian Xuesen, located at No.2 Fangguyuan, Hangzhou and at Lane No.1032, Yuyuan Road, Shanghai, were originally owned by Zhang's family. However, due to the disastrous failure of stock investment in the 1920s and 1930s, the Zhang family's economy went into decline and they had to sell their properties to pay their debts, and finally they could barely make ends meet.

Zhang Zhenzi had one son and three daughters: the son Zhang Leshan, the eldest daughter Zhang Lanjuan, and two younger sisters. Zhang Leshan was enthusiastic about local public welfare, actively participating in public welfare activities in Shanghai and Hangzhou. He was public personage with popularity, and was also the first member of the Zhejiang branch of the China National Road Construction Association.

Zhang Lanjuan was born at a time when her family was at its peak. Having received good family education and Chinese classical education, she was a cultured and courteous young lady. In her photos, Zhang Lanjuan was beautiful and dignified, with delicate facial features, showing a gentle and virtuous temperament. Although the marriage between Qian Junfu and Zhang Lanjuan was arranged by their parents and matchmaker, the couple was affectionate and got along very well, which was clear from the fact that Qian Junfu had no intention to remarry after his wife's death (Fig. 3).

Fig. 3 A photo of Zhang Lanjuan in her teenage years



After Qian Junfu and Zhang Lanjuan got married, the Zhang family gave them the house at No. 2 Fangguyuan as a dowry. Upon the bursting of Xinhai Revolution in 1911, Qian Junfu and his pregnant wife went to Shanghai to avoid chaos. Qian Xuesen was born in Shanghai on December 11 (October 21 in the lunar calendar) in the same year (Fig. 4). Qian Junfu and Zhang Lanjuan nicknamed Qian Xuesen as *Shen'er*, because the word “Shen” harmonized with “Sen”, and Shanghai was called “Shen cheng”. The word “Shen” was a double entendre. Qian Junfu also gave Qian Xuesen an alias, *Bai qing*, which were often called by Qian Xuesen’s classmates and friends.

In 1913, when the revolutionary tide subsided, Qian Junfu returned to Hangzhou with his wife and son, remained as the principal of the First Secondary School in Zhejiang Province. In 1914, Qian Junfu received the order to serve in the Ministry of Education and went to Beijing for his mission. He packed his belongings and went to Beijing alone to get prepared for the whole family. Before his departure, they took a family photo at the Dafangbo Photo Studio in Hangzhou to commemorate the occasion (Fig. 5). After Qian Junfu arrived in Beijing and settled in, he wrote to Zhang Lanjuan that she could bring their son to Beijing for reunion.



Fig. 4 A photo of Qian Junfu and Qian Xuesen in Shanghai (Qian Xuesen's first birthday)

In the early summer of 1914, Zhang Lanjuan and her son took a train from Hangzhou to Shanghai, waiting for the ship to travel north. During their stay in Shanghai, the mother and son took a photo at a photo studio. They arrived in Beijing by train after a stop in Tianjin, and the family was reunited after a short separation.

Mother's love is like water

Qian Junfu's student Huang Pingsun once described a scene: "The revered Mrs. Zhang said that Xuesen had such intentness in reading books that he only attended to the dishes close to his chopsticks while having meals. His mother would move the plates now and then so that he would eat more kinds of food" [10]. What Huang

had said vividly illustrated how Qian Xuesen was fond of reading on the one hand, and on the other hand it reflected the delicate feelings of his mother Zhang Lanjuan towards her son. Mother's love is like water! (Figs. 6 and 7)

Qian Xuesen once recalled that his mother had cultivated him the interest in "loving flowers and plants." Flowers and plants were representative of ecology and nature, the vitality of life. "Loving flowers and plants" was thus to cultivate her son's personality and enrich his emotions in the process of interacting with nature. The wisdom of Zhang Lanjuan was illustrated through another example. When Qian Xuesen was in elementary school in Beijing, his mother would ask him to trace nine characters with an ink brush in his winter vacations. These nine characters were "*Ting, Qian, Chui, Liu, Zheng, Zhong, Dai, Chun, Feng*", which composed a verse, literally meaning "the willow in front of the court was precious and waiting for the spring breeze." This was the famous "Nine-Nine Winter Diagram", which was said to be created by the mother of Emperor Xianfeng. Since the nine characters were all in nine strokes, Zhang Lanjuan gave Qian Xuesen a task, sitting at the table every day to trace a stroke. After 81 days, the coldest time of the winter holidays would be over. Through this method, not only did Qian Xuesen practice his brush writing, but he also exercised his patience and perseverance. This training and cultivation of willpower played an important "genetic role" in Qian Xuesen's scientific research.

When the Qian family lived in Beijing, Jiang Baili also worked in Beijing. During this period, Zhang Lanjuan hoped that they would adopt Jiang Ying, Jiang Baili's third daughter. This was the beginning of the love story between Qian Xuesen and Jiang Ying. As a matter of fact, both parents did not have the thought that Qian Xuesen and Jiang Ying would get married in one day. Zhang Lanjuan's original intention was to find a playmate for Qian Xuesen, so that her son, being the only child in the family, would not become unsociable and eccentric. Qian Xuesen had spent in Beijing for fifteen years, which was the bloom of his youth, and meant so much for him.

In 1929, after Qian Xuesen was admitted to Jiaotong University, his family moved back to Hangzhou. At the end of 1934, the warm-hearted Zhang Lanjuan introduced a girlfriend for the son of a friend living in Shanghai, and took a train from Hangzhou to Shanghai. Unfortunately, she was infected with typhoid fever on the train back to Hangzhou and died soon despite the treatment. At that time, Qian Xuesen was participating in the professional internship arranged by Tsinghua University. After receiving a telegram from his father that his mother was seriously ill, he immediately wrote to Tsinghua University and asked for leave to go home to visit his mother. The loss of his mother as a young man was undoubtedly a heavy blow to him.

In 1935, Qian Xuesen had a tombstone for his mother erected before he went to the United States. Whenever he thought of his mother, he would take out a group photograph with his mother and recall every bit of memory of her. In the summer vacation of 1947, Qian Xuesen returned to China for a short visit. The first thing he did was to sweep his mother's tomb in Hangzhou, accompanied by his father. He took some photographs of his mother's tombstone and surrounding scenery as a memento.



Fig. 5 A family photo taken in Hangzhou in 1914 before Qian Junfu went to Beijing to take up his post in Ministry of Education

3 Primary and Secondary Education

Qian Junfu's appointment to the Ministry of Education in 1914 was a personal promotion in his career. This promotion changed his life trajectory and also provided Qian Xuesen with the opportunity to receive a good primary and secondary education in Beijing. During the period when Qian studied in Beijing, the country was relatively stable politically and the economy was generally on an upward trend, providing a material basis and a favorable social environment for education.

Qian Xuesen's son, Qian Yonggang once summarized his father's experiences of receiving school education: "My grandfather was a section chief of the third

Fig. 6 A photo of Zhang Lanjuan and Qian Xuesen in Shanghai in the early summer of 1914



Department of the Ministry of Education. He was in charge of primary and secondary education. He sent his son to the best kindergarten, the best primary and secondary school at that time. Later, my father went to the best university in China and to the University of California, one of the best universities in the United States.”

The famous “Qian Xuesen’s question” put forward by Qian Xuesen in his later years was grounded in his own experience, especially his educational experiences in Beijing. Therefore, in his list of 17 teachers who influenced his life, eight were from his primary and secondary schools. The primary and secondary education set a cornerstone in Qian Xuesen’s education. What unforgettable experiences had his primary and secondary education brought to him? There are generally four important aspects, which Qian Xuesen himself often mentioned in various occasions.

Emphasizing on balanced academic development

The educational goal in Republic of China emphasized on integrity of students development, and a balanced school curriculum was designed to achieve that goal. Every course, major or minor, had its own value. Taking the primary school affiliated to



Fig. 7 A photo of Qian Xuesen and his mother Zhang Lanjuan

Beijing Women's Normal University where Qian Xuesen had attended as an example, the whole curriculum included five systems:

Semiotics: Chinese, Mandarin, composition, English, mathematics and so forth.

Science: history, geography, observation, natural science, family affairs and so forth.

Arts: arts and crafts, fine arts, practicing writing, sewing, cooking, music, sports and so forth.

General Knowledge: citizenship, health, gardening and so forth.

Specialized courses: calligraphy, lectures, performances, gatherings and so forth (Fig. 8).

Qian Xuesen still cherished a deep memory of his primary school experiences in his later years. On one occasion, Qian Xuesen attended a new year's party organized by the Commission of Science, Technology and Industry in Ministry of National Defense. He could not help bursting into tears while watching the film "Old Stories in the South of the City." The film was set in the primary school Qian Xuesen once attended. He commented: "Mr. Yu Shijian, the grade director, was my teacher and Comrade Deng Yingchao, who was there but had not taught our class. I missed them

Fig. 8 A photo of Qian Xuesen at the age of 10 when he was studying at the Primary School affiliated to the Beijing Normal University



so much.” He was deeply moved by the film’s theme song, *Farewell Song*, written by Li Shutong, a good friend of his father. Qian Xuesen often chanted the lyrics in his later years:

Outside the pavilion, by the side of the ancient road, the grass is green;

The evening wind blows the willows, the sound of the flute is broken, and the setting sun is beyond the mountain.

To the end of the world, to the corner of the earth, dear friends scattered;

A scoop of wine makes me happy; the dream of departing is cold tonight.

When the curriculum was designed in Beijing Normal University Affiliated High School (BNUHS) where Qian Xuesen studied, the emphasis was placed on a holistic and balanced development on the part of the students. The school had a “three-three system”, that was, three years of junior high school and three years of high school, where compulsory and elective courses were set to meet the individual needs of students.

Table 1 shows Qian Xuesen's study profile during the six years in HSBNU. It should be noted that Qian Xuesen took a German course as his second foreign language.

Emphasizing on the accumulation of extracurricular readings

The school curriculum was to some extent limited; therefore, extracurricular reading was considered as an effective way to expand students' scope of knowledge as well as a good way of self-study. There was a reading room in Qian Xuesen's primary school, which was not so spacious and opened twice a day. Students could read books and newspapers after lunch and after school. When Qian Xuesen entered HSBNU, he frequented to the school library. The library was small in size, but the collection of books was quite large. The collection was divided into two categories: classical novels of "liberal arts", such as *Romance of the Three Kingdoms*, *Journey to the West*, *The Scholars* and so on; and books on natural sciences, as well as books on science and technology. Borrowing classical novels required the approval of the Chinese language teacher, while books on science were freely available to all students.

When Qian Xuesen was a freshman in high school, once he browsed books in the reading room, Qian Xuesen spotted a book introducing theory of relativity and he went through the whole book out of curiosity. He recalled: "Although I did not understand it very well, I learned that Einstein's concept of relativity and the theory of relativity were confirmed by astronomical observations" [11]. There was no doubt that it was difficult for high school students to understand such a profound theory, but it stimulated Qian Xuesen's keen interest in natural science (Fig. 9).

Emphasizing on the consolidation of basic knowledge

If the foundation is not firm, the building will not be built high. One of the qualities that made Qian Xuesen so appreciated by his mentor Theodore von Kármán as a technical scientist was his mathematical endowment. The stimulation of this endowment owes to his high school mathematics teacher, Fu Zhongsun.

Fu Zhongsun's way to teach mathematics was "giving lectures and doing exercises." It proved that "exercise method" in mathematics learning was very effective in training logical thinking. Fu stressed that students should learn to discover regularity in the process of repeated exercises. This method could simplify complex problems and effectively improve the ability of logical thinking after long-term training. In this way, students could quickly find solutions when confronting complex problems. Obviously, Qian Xuesen had been effectively trained so that he outstripped others in the ability of logical and abstract thinking. Appropriate "exercise method" had positive effect on the understanding of book knowledge as Fu mentioned:

Learning should depend on practices, not just on listening to lectures. Students are required to listen to the lectures first and then do exercises by themselves. Even literature and art education need memorization! There are figurative thinking and logic thinking, while logical thinking is trained by doing exercises [12].

Therefore, when Qian Xuesen taught at China University of Science and Technology, he also stressed that the best way to learn basic subjects such as mathematics

Table 1 Qian Xuesen's school schedule at Beijing Normal University Affiliated High School

		Term	Compulsory courses (weekly class hours)				Optional courses (weekly class hours)	
Junior middle school	Grade 1	The 1st semester	Civics (1)	Chinese (7)	English (5)			
			Arithmetic (5)	Geography (3)	Physiology and Hygiene (1)		N/A	
			Botanics (2)	Painting and Crafts (2)				
			Physical education (2)	Scout Training (1)				
			Music and song (1)					
	Grade 2	The 2nd semester	Civics (1)	Chinese (7)	English (5)			
			Arithmetic (5)	Geography (3)	Physiology and Hygiene (1)		N/A	
			Botanics (2)	Painting and crafts (2)				
			Physical education (2)	Scout training (1)				
			Music and Song (1)					
Grade 2	The 1st semester	Civics (1)	Chinese (6)	English (6)				
		Arithmetic (5)	History (3)	Zoology (2)	Chinese (2)	Abacus calculation (2)		

(continued)

Table 1 (continued)

	Term	Compulsory courses (weekly class hours)			Optional courses (weekly class hours)		
Grade 3	The 2nd semester	Physics and chemistry (2)	Painting and crafts (2)		Business (2)		Crafts (2)
		Physical education (2)	Scout Training (1)		Painting (2)		Music and song (1)
	The 1st semester	Civics (1)	Chinese (6)	English (6)	Chinese (2)		Abacus calculation (2)
		Arithmetic (5)	History (3)	Zoology (2)	Crafts (2)		Painting (2)
		Physics and chemistry (2)	Painting and crafts (2)		Music and song (1)		
		Physical education (2)	Scout training (1)				
	The 1st semester				Chinese (2)		English (2)
		Civics (1)	Chinese (5)	English (7)	Arithmetics (2)		Minerals and geology (2)
		Arithmetic (5)	Geography (4)	Physics and chemistry (2)	Industry (2)		Chemistry craft (2)
		Physical education (2)	Home economics (2)		Accounting (2)		Music and song (1)
				Painting (2)			

(continued)

Table 1 (continued)

		Term	Compulsory courses (weekly class hours)				Optional courses (weekly class hours)					
Senior middle school	The 2nd semester		Civics (1)	Chinese (5)	English (7)	Chinese (2)	English (2)					
			Arithmetic (5)	Geography (4)	Physics and chemistry (2)	Arithmetics (2)	Minerals and geology (2)					
			Physical education (2)	Home economics (2)		Industry (2)	Chemistry craft (2)					
						Crafts (2)	Painting (2)					
						Music and song (1)						
	The 1st semester	Grade 1		Chinese (3)	English (5)	Chemistry (4)	Algebra (1)	Botanics (4)				
				Arithmetics (5)	Physical education (2)		Mineralogy (3)	Instrumental drawing (2)				
							Crafts (2)	Dialogue (1)				
							Short stories (2)	World geography (2)				
							General science (2)	Ethics (2)				
The 2nd semester						Psychology (2)	Drawing (2)					
						Music (1)	Embroidery (2)					
			Chinese (3)	English (5)	Chemistry (4)	Algebra (1)	Botanics (4)					
			Arithmetics (5)	Physical education (2)		Mineralogy (3)	Instrumental drawing (2)					

(continued)

Table 1 (continued)

	Term	Compulsory courses (weekly class hours)		Optional courses (weekly class hours)	
Grade 2	The 1st semester				Dialogue (1)
				Crafts (2)	World geography (2)
				Short stories (2)	Psychology (2)
				General science (2)	Music (1)
				Drawing (2)	
			Embroidery (2)		
		Chinese (3)	English (4)	Physics (4)	Advanced trigonometry (1)
		Arithmetics (5)	Physical education (2)		Geology (3)
				Astronomy (2)	Inorganic chemistry (4)
				Qualitative analysis (2)	Dialogue (1)
			Novels (2)	World history (2)	
			Economics (2)	Painting (2)	
			Music (1)	Sociology (1)	

(continued)

Table 1 (continued)

Grade	Term	Compulsory courses (weekly class hours)				Optional courses (weekly class hours)			
Grade 3	The 2nd semester	Chinese (3)	English (4)	Physics (4)	Politics (2)	Second foreign language (3)			
		Arithmetics (5)	Physical education (2)	Zoology (4)	Modern geometry (2)	Advanced Trigonometry (1)			
				Astronomy (2)	Geology (3)	Inorganic chemistry (4)			
				Qualitative analysis (2)	Dialogue (1)	World history (2)			
				Novels (2)	Economics (2)	General theory of law (2)			
	The 1st semester	Ethics (1)	Chinese (3)	English (4)	Painting (2)	Music (1)			
		Arithmetics (4)	Physical education (2)	Introduction to calculus (3)	Sociology (2)	Second foreign language (3)			
				Organic chemistry (3)	General biology (3)	Applied chemistry (2)			

(continued)

Table 1 (continued)

	Term	Compulsory courses (weekly class hours)			Optional courses (weekly class hours)		
					Mechanics (3)		Magnetolectricity (3)
					Dialogue (1)		Rhetoric (2)
					Introduction to philosophy (1)		Second foreign language (3)
	The 2nd semester	Ethics (1)	Chinese (3)	English (4)	Calculus (3)		General biology (3)
		Arithmetics (4)	Physical education (2)		Surveying (3)		Organic chemistry (3)
					Applied chemistry (2)		Mechanics (3)
					Magnetolectricity (3)		Dialogue (1)
					Rhetoric (2)		Second foreign language (3)

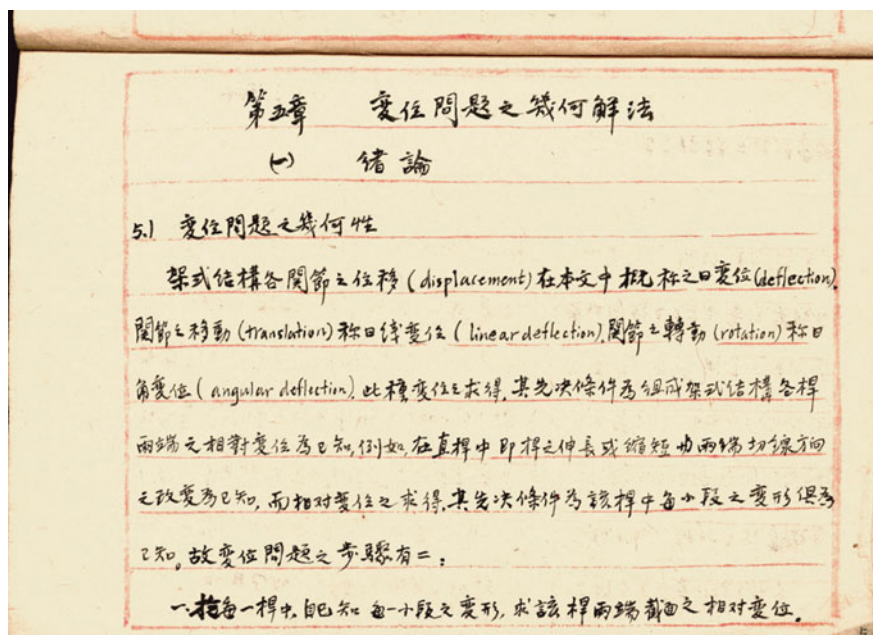


Fig. 9 Qian Xuesen's high school math workbook

and physics was to practice a lot, because “one would fail to recognize its true face if one was not proficient at it.” Memorizing formulas and methods were also necessary in order to apply them flexibly. “Exercise method” was not only an effective way to consolidate a learner’s foundation, but also an essential way to acquire proficient skills. “Without proficient skills, one may even make mistakes in simple copying work” [13], Qian Xuesen once said jokingly.

The teaching method of “giving lectures and doing exercises” requires patience, enthusiasm and carefulness on the part of teachers. Through teachers’ repeated explanations, students were able to grasp the knowledge system of the discipline, understand its composition and correlation, and finally construct a macro and micro knowledge system by themselves. Qian Xuesen mentioned that the teachers in HSBNU were very patient, and would give students assignments in natural science class, in Chinese and foreign language classes as well, which benefited him a lot [14]. For example, Fu Zhongsun often gave students in his science class some extra tutoring, and taught them advanced college-level courses, like calculus. “The courses in the first year of Shanghai Jiaotong University were too easy to me, as I had already learned these courses in high school and I had learned them well” [15], Qian Xuesen said later on.

Emphasizing on the cultivation of practical ability

In Republic of China, from elementary school to high school, practical courses were compulsory, which aimed to cultivate students’ observation and hands-on skills,

effectively combine textbook knowledge with practical knowledge, and deepen their understanding of textbook knowledge in application. The curriculum in Qian Xuesen's elementary school covered many practical courses, such as household chores, crafts and sewing. Through learning these courses, the students would not fall into the inertia of "having rice put to their mouths and clothing to their hands". When Qian Xuesen entered the HSBNU, the proportion of practical courses in the curriculum increased, and teaching methods used in these practical courses were varied, which could be illustrated through two teachers.

One was Qian Xuesen's biology teacher Yu Junshi, who attached special importance to the cultivation of students' ability to observe nature and use their heads and hands by collecting and making specimens. In his letter to Yu Junshi on February 5, 1982, Qian Xuesen pictured scenes over 60 years ago: "I went to the Temple of Heaven in Beijing with my teacher to collect insect specimens and you provided us with glass alcohol bottle in collecting snake. Afterwards we had egg and bean curd soup in *Huai lu*, your residence. I was very grateful for your instruction. What I might have done for my country and people owed to your enlightenment and instruction" [16].

The other was Wang Heqing, Qian Xuesen's chemistry teacher, who attached special importance to the combination of chemical principles and chemical experiments. He encouraged students to learn theoretical knowledge while observing phenomena by participating in experiments. Wang Heqing suggested that students could go to the laboratory whenever they were interested to do experiments under his personal guidance. Qian Xuesen developed a strong interest in chemistry in HSBNU. He studied organic chemistry, inorganic chemistry, applied chemistry, which were supposed to be offered in university. This teaching method of combining theory and practice could enable students to learn not only knowledge but also to understand the learning process. Qian Xuesen commented: "The main thing was not in memorization, but in understanding."

HSBNU occupied an important place in the history of secondary education in the Republic of China and many teachers in HSBNU had innovative educational ideas including combining theory with practice. Yu Junshi and Wang Heqing were just two representatives of these teachers (Figs. 10 and 11).

Lin Liru, the then principal of HSBNU was another scholar worth mentioning. Lin was the director of the Education Department of Beijing Normal University, and the principal of HSBNU was his "part-time job". It was he who implemented the "three-three system" and advocated the teaching philosophy of "whole-person cultivation", which led to a rapid improvement in the teaching quality of the affiliated high school. Qian Xuesen wrote to Lin Andi, Lin Liru's daughter, on September 21, 1989, "Mr. Lin was my revered teacher and I was very grateful for the kind of education in HSBNU under his leadership." That was the reason why Qian Xuesen especially emphasized the role of principals, "It was very important for a school to have a good principal and appropriate educational policies," when he talked about education in his later years.

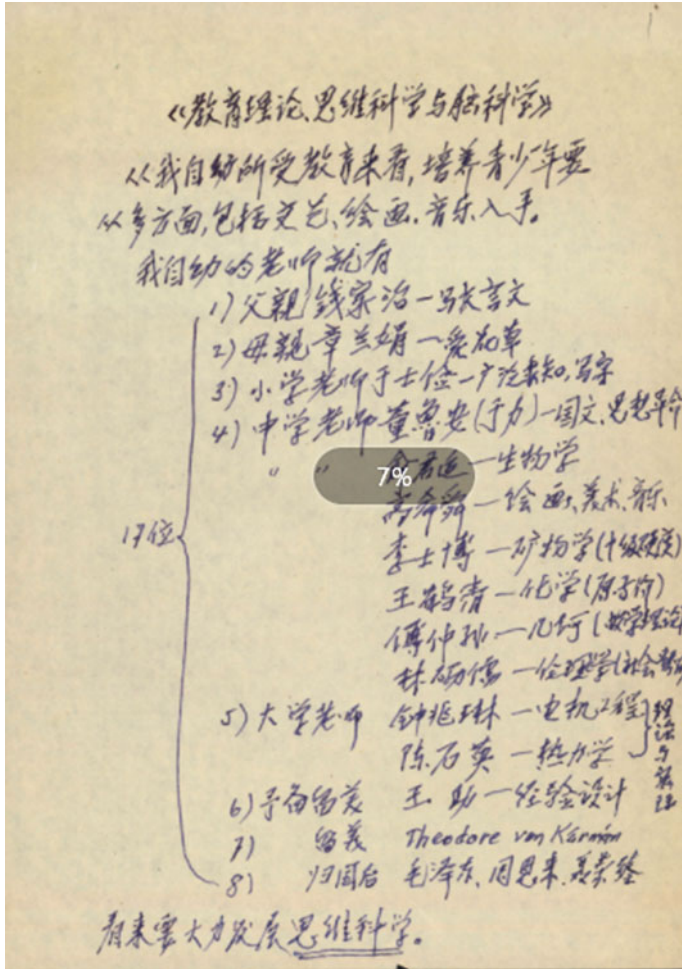


Fig. 10 Seventeen teachers who exerted important influence on Qian Xuesen

4 Family Education

“To write *wen yan wen*, or the classical Chinese was my father’s biggest influence on me”, Qian Xuesen said. Writing *wen yan wen* actually stands for Qian Junfun’s valuing on Chinese culture and humanism. Qian Junfu attached great importance to family education and teaching by precept and example in daily life. This concept of family education endowed Qian Xuesen with artistic and humanistic qualities, laying down the basis for him to be a scientist. To borrow a word from Tu Yuanji, the secretary of Qian Xuesen: “Qian Junfu was a talented person, but his talent was not on full display. His greatest contribution was the cultivation of Qian Xuesen for the country.”

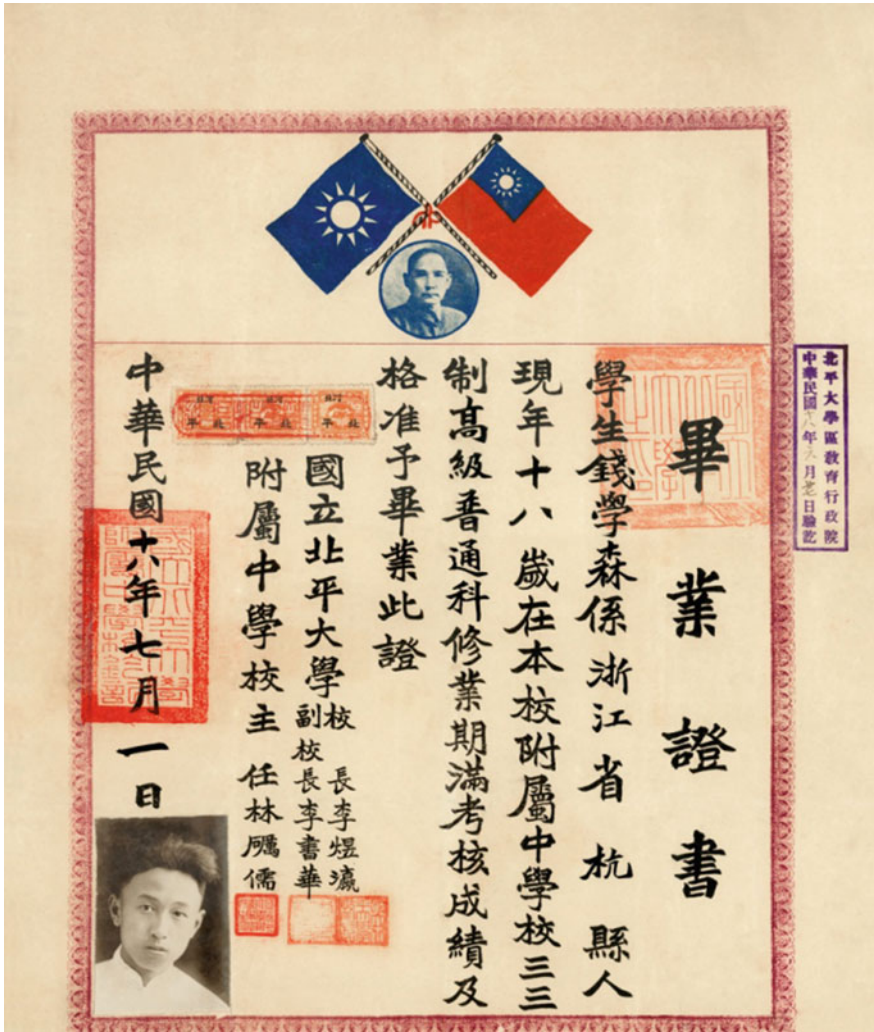


Fig. 11 In July 1929, Qian Xuesen received his diploma from the Secondary School affiliated with National Beiping University (National Beijing Normal University was changed to “National Beiping University” due to the implementation of the graduate school system.)

The concept of family education

Qian Xuesen’s great achievement attributes to his father, the educationalist Qian Junfu. Qian Junfun was majored in educational theory and had more than twenty years of experiences in practices of saving the nation through education. He taught in colleges and high schools, and also took offices in the educational administrations. He was deeply aware that family education was an indispensable part in the cultivation

of “a whole person” and it was an important part of the whole educational system. He said:

I am doubtful about the way some Chinese families educate their children. School and families are equal partners in children’s education. Only when the two kinds of education complement each other can they be effective in cultivating a child. Some families thought they had fulfilled their duties by sending their children to school. This is completely wrong! Some people blamed school education but never reflected on their family education. What a pity to be tolerant of yourself while to blame on others! I hope that the parents will realize the importance of cooperating with the school. In this way, our education would make great progress and our children would have an optimistic future [17].

Qian Junfu regarded it urgent to change some parents’ view that children education should totally depend on school. He compared a life journey with a ship sailing in the sea. He said, “A ship could not escape the fate of capsizing without a solid hull, a strong sail and an accurate rudder.” The implication is that one’s overall development attributes to a healthy body, sufficient knowledge and high morality, that is, all-round development of morality, intelligence, physique and aesthetics. Because of this, Qian Junfu particularly focused on family education. It was blessing for Qian Xuesen to have a father who understood education so profoundly.

The content of family education

Qian Junfu’s concept of family education could be understood in broad and narrow sense. The broad sense of family education focused on cultivating Qian Xuesen’s humanistic temperament and artistic interests, and training his ability to think figuratively. This ability helped Qian Xuesen to think in a “big way” and played a significant role in his scientific career. In his later years, Qian Xuesen recalled with gratitude:

My father, Qian Junfu, knew a lot about modern education. On the one hand, he asked me to study science and technology; on the other hand, he sent me to take art lessons like music and painting. I am not only interested in science, but also in art, and I have read many books on art theory when I was a student at Shanghai Jiaotong University, like George Plekhanov’s *Theory of Art*. These artistic interests not only deepen my understanding of poetic feelings and philosophies of life in art works, but also enable me a macroscopic thinking characterized in arts” [18].

Qian Junfu often asked his friends, some of who were famous cultural scholars, to tutor his son. With his father’s arrangement, Qian Xuesen had received fine artistic and humanistic edification.

In 1917, when Qian Xuesen was six years old and about to enter elementary school, his father took him to the home of Sun Jincai to learn the art of calligraphy. Sun Jincai was a late Qing dynasty scholar who not only had a reputation for calligraphy in the Republic of China, but also well versed in Chinese traditional learning. Qian Xuesen later recalled the first day of his calligraphy class, “My teacher wrote a short sentence for me to imitate, and that was the beginning of my calligraphy learning.” Sun Jincai not only taught calligraphy, but also explained the schools of calligraphy and the Chinese culture. Qian Xuesen had always regarded Sun Jincai as his enlightenment teacher, who later wrote the “mandarin duck album” for him and Jiang Ying.

As calligraphy and painting was from the same origin, Qian Junfu found that his son developed an interest in painting while practicing calligraphy. He asked his best friend Gao Xishun to teach Xuesen painting. Qian Xuesen learned the painting skills quickly. He said happily to his parents: “While observing and drawing, the scenes melt into my mind. I forgot everything at that moment. My heart was so pure.” After the Qian’s family moved to Hangzhou, Qian Junfu had some of Qian Xuesen’s paintings framed and hung in their home. Unfortunately, when Japanese bombed Hangzhou in 1937, those paintings were destroyed.

When Qian Xuesen was thinking about education in his later years, he said bluntly, “It was a fine tradition of Chinese intellectuals that professors were not only scientists and engineers, but also literary scholars and poets. It was a pity that this tradition had nearly died out among today’s young and middle-aged people!” [19] When he recalled the humanistic and artistic training he received in middle school, he said with pride, “I myself painted watercolors and Chinese paintings, played the violin, and wrote short essays in middle school. In college, I played the horn and participated in the school’s wind band. It should be noted that figurative thinking, as inexpressible as it was, was different from abstract thinking” [20].

Qian Junfu’s family education in a narrow sense means extracurricular tutoring. Qian Junfu had invited tutors for Qian Xuesen during elementary and middle school years. Before the college entrance examination, Qian Xuesen was tutored by Zhao Naituan, a student at Peking University, majored in Chinese and English and Luo Wen, a student at Beijing Women’s Higher Normal University, majored in mathematics, physics and chemistry. Interestingly, the two tutors were dating with each other. Zhao Naituan was a student of Qian Junfu when he was the principal of the First Secondary School in Zhejiang Province and he was facing financial problem and nearly dropped out of school at that time. Qian Junfu asked both of them to come to his home to tutor Qian Xuesen, which helped solve their financial problems.

Discussions on learning between father and son

Qian Junfu had developed his own reading method as a student, an efficient “three-step reading method”, which he passed on to his son. Every summer vacation, Qian Junfu gave his son a reading list and he himself also read the books in the list. The first step of reading was skimming and scanning, aiming at understanding the gist of content. The second step was intensive reading. The third step was to focus on the key parts by taking notes. Qian Junfu would review all the notes that his son had put down.

This method of reading was a good way for father and son to share their knowledge with each other. By reviewing his notes, Qian Junfu could know how much his son had learned from these books and what he was thinking. This method of reading was also very useful in expanding his knowledge scope, providing him an access to wider areas of knowledge than he could learn in school, and also stimulating his desire to learn. What is less well known is that this method of learning has also played an important role in inspiring Qian Xuesen to embark on aviation and aerospace.

Qian Junfu had the habit of reading newspapers and periodicals, and he was especially concerned with the development of science and technology in the world.

He had accumulated a wealth of aerospace knowledge through years of reading. On March 7, 1932, during his tenure at the Education Department of Zhejiang Province, he delivered a keynote speech entitled “*Having the Knowledge of Aviation in Fighting with the Invaders.*” He analyzed the international and domestic situations from four aspects, namely, aviation industry, air force organization, aviation force and aviation management. At that time, Japanese invaders were swollen with arrogance, invading Shanghai and bombing Hangzhou with the advantage of aircraft. Qian Junfu’s speech inspired the audiences greatly. At the end of the speech, Qian Junfu called for the cultivation of aviation talents in China as “Germany and Japan had developed the students’ interest in aviation from their primary school years”, but “China lagged behind.” Therefore, he called for vigorous cultivation of aviation talents.

In fact, Qian Junfu had an in-depth conversation with Qian Xuesen before preparing the lecture, discussing the current state of aviation in the world and the prospects of developing aviation in China. After that, Qian published six articles on aerospace from 1933 to 1935, and the examples, data and some ideas used in Qian’s articles were the same or similar to those given by Qian in his lectures. This historical detail revealed that the mutual learning between father and son was most likely the source of the ideas that led Qian to aerospace research. Eventually, Qian Xuesen was admitted to Tsinghua University in 1934 as a Boxer Rebellion Scholarship recipient in the “aviation engineering (rack group)”, fulfilling his father’s dream.

In their family education, Qian Xuesen’s parents had fully respected his interests and guided him to develop positive outlook on life. Therefore, the comment Qian Xuesen had made that “was nurtured and educated by my father and mother” was thought-provoking for parents nowadays.

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