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A SHORT BIOGRAPHY OF FUJI ZHANG

— A Chinese Mathematician and Educator

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Fuji Zhang, one of the pioneers in the studies of mathematical chemistry in China, is a highly respected mathematician and educator. He has made remarkable contributions in research as well as in education, despite the fact he lost thirteen years in the prime of his life due to political persecution and nationwide turmoil. Although none of us were "official" graduate students of Professor Zhang, each one of us had the great fortune of being guided by him to enter the research field of graph theory and its applications in chemistry. It is a privilege for us to write about him on the occasion of his 70th birthday; it is also a great challenge to do justice in a few paragraphs to his extraordinary career and legendary life. We hope our short biography of this outstanding Chinese intellectual will be a tribute to his accomplishments in the field of mathematical research and his lifelong dedication to education.

Fuji Zhang was born on December 16, 1936 in Chengdu, a large city in the Sichuan province of China. During his childhood Zhang loved to read a wide variety of books, from poetry to the sciences. It was in high school that he developed a strong interest in science as

the result of reading a well known series entitled "Liberal Youth", which popularized basic scientific ideas in modern physics, chemistry and calculus. He soon realized he preferred the theoretical and abstract nature of mathematics to the hands-on, practical aspects of laboratory work. He therefore selected math as his major and was admitted to the Beijing Normal University after passing the entrance examination in 1954. The courses that interested Zhang most were Modern Algebra and Mathematical Logic taught by Professor Shi-Qiang Wang. Before taking Professor Wang's courses, Zhang had heard many stories about him. For example, Wang was hired as a math lecturer immediately after graduation from college, and he had solved an open problem in the famous book *Lattice Theory* by G. D. Birkhoff. Zhang also learned that Wang lived a simple life and fully devoted himself to research, even when he was ill. These stories greatly aroused Zhang's curiosity about Wang and his courses. Zhang was deeply impressed by Professor Wang's perceptive and rigorous lectures, from which he clearly saw the elegance and beauty of mathematics. This became particularly evident to Zhang when Wang introduced Gödel's Incompleteness Theorem. Zhang was struck by the depth and philosophical significance of this great theorem. In Wang's seminar, Zhang studied van der Waerden's *Modern Algebra* and part of Birkhoff's *Lattice Theory*, and the Ring Theory from Professor Shao-Xue Liu's lectures. At the same time Zhang self-studied *Introduction to Mathematical Logic* by A. Church. In the spring of 1957, he started to read foreign math literature under Wang's guidance, which further increased his interest in math research. However, Wang's seminar for cultivating young researchers soon came to an end in the summer of 1957, when China's political climate underwent an unfortunate and disruptive change. During the so-called Anti-Rightist campaign, many well-known intellectuals were accused of being "anti-Communist Party" and "anti-Socialism." The vice president of Beijing Normal University, Professor Chong-Sun Fu, a famous mathematics educator, was condemned as a "Rightist" causing heated debates within the department of mathematics. Unfortunately, Wang was also affected. Zhang and other students in Wang's seminar were angered at what they saw as the extremely unfair treatment of their respected professors. They vigorously defended Professor Fu in the public debates. As a result, Zhang was classified as an "Extremely-Right Student" in 1958. He was placed on probation and sent to a farm for three years to receive what was known at this time as "transformation of thinking through labor". Zhang suffered a great deal during this difficult period, but the hardship toughened him so that eight years later he could survive more severe persecution during the "Great Cultural Revolution" — the greatest disaster to befall the People's Republic of China.

In 1961, Zhang was permitted to return to the Beijing Normal University. He found out Wang's seminar on pure mathematics was no longer being offered since pure math had been classified as "bourgeois" and useless. He enrolled in Professor Shi-Jian Yan's class on Probability and seminar on Stochastic Processes. Professor Yan's rigorous training and enthusiasm for applied math research had a great impact on Zhang — he decided to study the Queuing Theory. In the following year, Zhang graduated from the Beijing Normal University

and was assigned to teach at a middle school in the small town of Hami, in the Xinjiang Uygur Autonomous Region, which was remote and undeveloped. Before Zhang left Beijing, Professor Yan told him, "No matter how poor the environment may be, as long as you persist in research, you will be able to overcome all kinds of difficulties and get excellent math results." Professor Yan also told him that the renowned mathematician Wen-Jun Wu was once a middle school teacher, too. With these words of encouragement from Professor Yan, Zhang set out for Hami.

As a middle school math teacher, Zhang had a heavy teaching load of 15 hours of lectures per week, grading all homework assignments, quizzes and exams himself. Determined to keep his interest in higher levels of math alive, he formed an informal seminar with his colleagues where they discussed higher and more challenging aspects of mathematics each week. He also spent many hours per week on the mandatory political study — a requirement for all teachers. Despite all these demands on his time, Zhang managed to study math on his own for at least two hours every night after his students had gone to bed, as well as on weekends and holidays. Every year when he went to Chengdu to visit his parents, he spent time there in the libraries reading math literature, a luxury not afforded him in rural Hami. Zhang's first math paper was submitted to the Chinese math journal *Advances in Mathematics* and received favorable reports for acceptance from the referees. However, in order to get a paper published at that time, Zhang was required to provide an official letter of certification from the Communist Party leadership of his school. Because of his political record, his request for such a letter was denied; in fact, he was accused of "taking the path of anti-socialism". Furthermore, Zhang was forced to disband the seminar he had organized with his colleagues.

When the disastrous "Great Cultural Revolution" began in 1966, a large number of people in China were caught up in a frenzied drive to achieve "doctrinal purity," resulting in the persecution of millions. Zhang's mathematical research in "Queuing Theory" was seen as "an attack that the socialist system caused long lines of people waiting in front of shops because of a scant supply of commodities". Zhang's small dormitory room was searched and his personal papers — manuscripts of poems and communications with friends — seized; these became further proof of his anti-revolutionary ideology and activities. Zhang was sent to a"cowshed" (a place for confining politically problematic people) where he underwent further investigation. While there, he was psychologically and physically tortured; he suffered permanent damage to his ribs from the cruel beatings. Even worse, Zhang's younger brother, a talented 29-year-old scientific researcher at the Institute of Mechanics in Beijing, committed suicide because the political persecution he was subjected to had become unbearable. Despite the fact Zhang was bleeding both in his soul and body, he never lost his belief that science was an important part of humanity and sooner or later it would shine again in China. He utilized every moment of respite — either in short breaks during heavy physical labor or in a few longer periods when things quieted down during those troublesome years — to continue

his math study. Thinking about fine mathematical structures and conclusions deduced from very natural basic concepts gave him a relief from the harsh reality of life and helped him to survive this dark decade.

When the "Great Cultural Revolution" ended in late 1976, China experienced a great transformation. The blossoming spring of science hoped for by Zhang and most Chinese intellectuals finally became a reality. When Zhang was able to access math literature from the outside world, he was astonished to find that among the math results he himself had obtained in the secretive and difficult environment of the previous decade, most had already been published by other researchers. Fortunately, the remainder of his math results were soon published as five papers in Chinese math journals.

Zhang's life was changed by an event in the summer of 1977, when the world-renowned Chinese mathematician Loo-Keng Hua (one of the very few great Chinese scientists who received the protection of top Chinese leadership during the chaotic period of the "Great Cultural Revolution") came to Urumqi, the capital of Xinjiang Uygur Autonomous Region, to popularize the Optimum Seeking Method and the Statistical and Operational Methods for improving production control. In the office of the Xinjiang Science Committee, as Hua was shown recent applications for math research grants, he saw Zhang's manuscript on the mathematical study of molecular orbits. He was quite surprised by the fact that this work was done by an unknown math teacher in a very isolated location during such an extremely difficult period for scientific research. Hua immediately invited Zhang to meet with him in Urumqi, where he strongly encouraged Zhang to continue his work of applying mathematics in science. Because of Hua's great prestige and the change in the political climate, the situation Zhang faced was profoundly altered. He no longer had difficulty getting the necessary certification for publishing his research in math journals in China. (A few years later, the requirement for the certification letter for publishing in China was done away with.) Zhang's manuscripts on Queuing Theory attracted the attention of Professor Zi-Kun Wang (a well-known mathematician in Probability Theory in China). On Wang's recommendation, Zhang was invited to attend the conference on Operations Research held in Chengdu in 1978. This event marked an important change in Zhang's life; he was now rescued from his isolation and was able to reestablish contacts with many colleagues in the Chinese Mathematical Society.

In the late 1970s, because Zhang now had access to foreign math literature, he discovered that Graph Theory and Combinatorics were developing very rapidly overseas and saw a rising number of important applications in the natural sciences as well as computer science. Zhang was inspired to merge his own research with this worldwide trend. He found himself strongly attracted to Mathematical Chemistry. There are many interesting problems in this interdisciplinary field where chemists' research and intuition often provide helpful inspiration, and it is very exciting for mathematicians to see their work being interpreted and applied in the physical world. With the publication of Zhang's first series of papers, Zhang's great

talent in mathematics became widely recognized. He was invited to move to Urumqi to teach in the department of mathematics at Xinjiang University in the fall of 1981. At that time, this university, the largest in Xinjiang, was mainly a teaching institution with a few research programs. To change the atmosphere in the mathematics department, Zhang first organized a research seminar. The members of the seminar included his graduate students and some new faculty (including three of us). All the members took turns presenting what they had learned from various monographs and recent journal articles as well as their own new work. During discussions, Zhang used every opportunity to reveal the whole process of math research: how to find an appropriate problem, how to develop the main idea, how to overcome the obstacles, and, finally, how to change intuition to a rigorous mathematical proof. He often presented his own speculative ideas and asked thought-provoking questions, prompting discussion and debate among seminar members. In this way he created interest in — rather than fear of — the mystery of research, greatly stimulated seminar attendants' thinking, and aroused their enthusiasm for creative work. By the end of 1980's, Zhang had successfully made his group an active unit of research in graph theory and combinatorics in China. Most of the members in his seminar, because of their successful endeavors, were promoted to professors in a relatively short period.

Not long after Zhang moved to Xinjiang University, he was appointed head of the math department. While he knew this job would take time and energy away from the research he loved, he accepted it with the hope of achieving something he had dreamed about ever since those difficult days in 1957 at the Beijing Normal University, i.e., he wanted to create an environment in which every faculty member could think and do research freely and all diligent efforts, whether in teaching or research, would be fully respected. In addition to personally inviting some faculty members (with a math background close to his own) to engage in research with him, Zhang also encouraged and supported the development of everyone in the department. To nurture researchers in other branches of mathematics, such as differential equations, functional analysis, differential geometry, probability and scientific computing, Zhang sought out capable faculty members through a fair and rigorous selection process, sending them to study in the best graduate schools in Beijing, Shanghai, or overseas. Zhang also paid particular attention to cultivating graduate students and faculty from various minority groups in Xinjiang. Most of them later played important roles in math teaching and research in Xinjiang University after they received advanced degrees.

Zhang also founded the Institute of Mathematics and Physics at Xinjiang University. Under his leadership as director of the Institute, researchers in Math and Physics obtained funding from the National Natural Science Foundation of China. In the winter of 1988, Zhang was appointed vice president of Xinjiang University. In this position he devoted much of his energy to the development of strong faculty teams in key disciplines to advance the growth and reputation of the university. He played a major role in important reforms of the rules

and regulations for faculty development and promotion, which greatly stimulated faculty members' enthusiasm for research in the university. Because of his achievements, Zhang was honored as a "Nationwide Model Educator" and an "Excellent Scientific Researcher in Universities of China". With his students X. F. Guo and R. S. Chen, Zhang also won the "Science and Technology Progress Award" from the National Education Ministry of China.

In 1994, Zhang moved to Xiamen University - a move prompted in large part by recurring difficulty with his rib injury suffered during the "Cultural Revolution" and made worse with advancing age, especially with the severe winters in Xinjiang. Before his arrival, there was no one conducting research in combinatorics and graph theory in the math department of Xiamen University. So, Zhang concentrated most of his energy in expanding his research and cultivating new researchers. Because of Zhang's efforts, a new active research group in combinatorics and graph theory was established in a few years. He and his masters and Ph.D. students made various new discoveries, not only in mathematical chemistry but also in general matching theory, networks and knot theory. At the same time, Zhang continued to maintain interest in the developments at Xinjiang University, especially the Department of Mathematics and the Institute of Mathematics and Physics.

During the past two decades, Zhang has visited many research universities and institutions in Asia, Europe and the United States. He has published more than 200 research papers. Zhang's coauthors, from universities in China, Europe and North America, have always appreciated his unusual vision, keen insight, thought-provoking ideas, prompt and helpful feedback and kind friendship. He supervised many graduate students with great care, twelve of whom have earned doctorates (Jixiang Meng, Heping Zhang, Qiongxiang Huang, Jinjiang Yuan, Huaien Li, Jianguo Qian, An Chang, Lianzhu Zhang, Weigen Yan, Jianping Ou, Haiyan Chen and Xian'an Jin).

Professor Zhang married at the age of 47 and has a happy family. His beloved wife Qing Liu was once his student and colleague in Hami and is now the managing editor of the *Journal of Mathematical Study* of Xiamen University. Their love story has been admired by all their friends. They have one son, Zuhe Zhang, who is graduating this summer from Sichuan University at Chengdu, where his father was born seven decades ago.

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