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Hua Loo-Keng's Popularization of Mathematics and the Cultural Revolution

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Before 1966, Chinese mathematician Hua Loo-Keng had singled out ''Two Methods'' as a way to truly applied and useful mathematics. The Overall Planning Method, based on the Critical Path Method widely used in USA, mostly appealed to middle and upper management. This limited its spread during the Cultural Revolution. The Optimum Selection Method, also of US origin, was more mass-oriented and ready for popularization. Nevertheless, Hua met resistance from leftist radicals, whose ideological objections sprang from an underlying power struggle. Hua built popularization teams, mostly from talented younger people whose careers were disrupted by the Cultural Revolution, and thus opened a path for many of them to important roles in China's scientific infrastructure after 1976. Hua Loo-Keng's efforts, while interrupted during the Cultural Revolution and the subsequent political campaigns, were also helped by the populist ethos of the movement, and by the lack of other non-political endeavors at that time. In this sense, the Cultural Revolution gave Hua Loo-Keng's popularization its importance and long-term impact.

Introduction

The Cultural Revolution (CR) period (1966–1976) brought a lot of disruption to Chinese mathematics. Normal activity of universities and research institutions was suspended during intense political struggle and military control of 1966–1971; after the death of Marshall Lin Biao in 1971, mathematical research was possible again but still subordinated to politics. The victors of the revolution, radical leftist activists, wanted the scientists to share their laboratories with ordinary workers, peasants and soldiers ("open door research") and to follow their interpretation of Maoist ideology, which forbade elitism and pursuits of arcane subjects "divorced from the masses". They emphasized science popularization and the engagement of ordinary people in collaborative research projects, which was easier and more promising in empirical disciplines such as paleoanthropology and seismology[1] than in mathematics.

Most mathematical researchers at the pinnacle of China's scientific establishment, in the Chinese Academy of Sciences, either continued working in the old way, perfunctorily inserting some slogans into their papers, or abandoned research in favor of specific tasks for the military. But the most prominent of Chinese mathematicians, Hua Loo-Keng (1910–1985), wanted to fulfil both the new requirement to face the masses and the older leftist invocation to "theory linked to practice" by going to factories and communes and teaching everyone simple but powerful methods of Overall Planning and Optimum Selection. Paradoxically, this did not protect him from resentment of the radicals. Intellectuals were supposed to dutifully follow the masses, not lead a movement. On the other hand, many questioned why a famous mathematician like Hua travelled around China teaching poorly educated people the basics of two simple methods, which anyone could do.

In this paper, I will try to use Hua's case to show how the Cultural Revolution shaped scientists' work and its social forms, which remained important long after the death of Mao Zedong and the repudiation of the Cultural Revolution.[2]

In the first part, I will review how Hua, several years before the Cultural Revolution, came to his decision to abandon academic mathematics in favor of teaching mathematical methods to "the masses". The second section details Hua's initial steps towards popularization: adaptation of an approach found in US documents into the Overall Planning Method (OPM), and its trial deployment,

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[1] For paleoanthropology, see Sigrid Schmalzer: *The People's Peking Man: Popular Science and Human Identity in Twentieth Century China*, Chicago: University of Chicago Press 2008. Seismology was studied by Fan Fa-ti: "'Collective Monitoring, Collective Defense': Science, Earthquakes, and Politics in Communist China," *Science in Context*, March 2012: 127–154.

[2] Hua's popularization was studied as a successful approach to didactics of mathematics by Jean W. Richard, who had access to translations of booklets for "inner circulation" published about the Optimum Selection Method in the 1970s. A summary of his unpublished Ph.D. dissertation is in J. W. Richard, "Hua Loo-keng and the Movement of Popularizing Mathematics in the People's Republic of China", *Journal of Mathematics Education at Teachers College*, Fall – Winter 2010, p. 22–27. Richard focuses on the mathematical and didactic aspects of Hua's popularization, which he sees rather uncritically as an embodiment of Maoist philosophy.

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virtually stopped by the Cultural Revolution. The third section shows Hua resume popularization in 1971 with emphasis on the Optimum Selection Method (OSM) he designed in 1966 for trial-and-error applications. This was more successful than OPM chiefly because it engaged more ordinary workers. The last section situates Hua's popularization effort in the politics of the CR period, but also in Hua's personal motivations, and gives a tentative assessment of its long-term contribution to China's science.

Much of my account is based on how Hua's movement has been remembered more than 30 years later by his followers.[3] I am aware of the one-sided nature of this type of evidence, which can only be supplemented by a few newspaper articles and brochures from the 1970s and Hua's personal recollections from the early 1980s. The voices of Hua's students and followers are however useful for showing how the responses elicited by the Cultural Revolution among Chinese mathematicians and technical intelligentsia shaped Chinese society for years after CR had been completely repudiated.

Hua Loo-Keng's Move to Popularization

Hua Loo-Keng (pinyin: Hua Luogeng 华罗庚, 1910–1985) was a merchant's son from Jintan, Jiangsu, who dropped out of school at the age of 17 due to family poverty.[4] Despite this educational disadvantage and a life-long disability from polio, Hua Loo-Keng became one of the most prominent Chinese mathematicians of the twentieth century. He showed phenomenal talent in the technically challenging analytic number theory, theory of complex functions and non-commutative algebra. Equally important were his ambition, perseverance, showmanship and political savvy, but also the special opportunities he received despite his lack of formal education. In 1930, a letter to the scientific magazine *Kexue* demonstrating an error of a mathematical article published there a few years earlier earned him the position of "assistant" at the Department of Mathematics of Tsinghua University, free to attend the lectures and use the library. Tsinghua sent him to Cambridge (1936–1938) and appointed him full professor based on his work done there. Hua worked at Princeton and the University of Illinois at Urbana-Champaign after WWII, but returned to China in 1950 as a vocal supporter of the new regime,[5] becoming director of the Institute of Mathematics of the Chinese Academy of Sciences (IMCAS)[6] and member of the Standing Committee of China's National People's Congress in July 1956.[7]

The leadership of the People's Republic of China emphasized that science ought to serve the people. Hua Loo-Keng fully agreed, and as director of IMCAS pursued a strategy for Chinese mathematics where most resources went into fields such as differential equations and statistics, seriously neglected before 1949 and most relevant for the buildup of industry under the planned economy. Hua was himself active in the establishment of Chinese computational mathematics, supplying algorithms for numerical solutions of analytically intractable problems. He popularized applicability of mathematical knowledge in newspaper articles and published lectures. At the same time, in the 1950s Hua believed that serving the people could be accommodated within standard academic mathematics, and the goal should be to expand the latter and raise its overall technical level. He led the establishment of a high school mathematical competition, based on the Soviet model of elitist mathematical education, and continued to teach his techniques in number theory, algebra and function theory to a select few talented graduates until 1958.

Hua's clout over IMCAS was however seriously undermined by his involvement in the drafting of "Some Suggestions on Problems in Our Country's Science Regime", a document solicited by the Party during the 1956 Hundred Flowers Campaign but criticized as "Rightist" in June 1957. During the Great Leap Forward (GLF) in 1958–1960, traditional academic mathematics was condemned for hindering "linking theory with practice", a key Maoist demand on all science. Hua was criticized as primarily responsible, especially for his teaching of advanced fundamental branches, however limited. Even though fundamental research and academic excellence were partly reinstated after the abject failure of the Great Leap Forward, Hua's standing in IMCAS was irreversibly damaged.

In the 1960s, Hua increasingly focused on his work at the Department of Applied Mathematics at the University of Science and Technology of China (USTC). Hua had been involved with the university, established in 1958 to train rigorously researchers for the expanding Chinese Academy of Sciences, since its beginnings, became one of its vice-presidents in 1961 and designed its course of higher mathematics, which he taught personally for the first three years. In 1964, he moved from CAS entirely to USTC, now a top-tier university along with Peking and Tsinghua universities, and remained only a nominal director of IMCAS. In this period, he led the students of the Operations Research (OR) specialization of the mathematics major to focus on applications of mathematics.[8]

[3] Especially in the festschrifts for Hua Loo-Keng's centenary, i.e. Xu Weixuan 徐伟宣 (ed.), *Tiejin renmin de shuxuejia Hua Luogeng* 贴近人民的数学家华罗庚 [Hua Loo-Keng, a Mathematician Close to the People], Beijing: Kexue chubanshe, 2010; and Qiu Chengtong 丘成桐 et al., *Chuanqi shuxuejia Hua Luogeng – Jinian Hua Luogeng danchen 100 zhounian* 传奇数学家华罗庚 – 纪念华罗庚诞辰 100 周年 [The Legendary Mathematician Hua Loo-Keng – Remembering 100 Anniversary of Hua Loo-Keng's Birth], Beijing: Higher Education Press, Sommerville, MA: International Press 2010.

[4] Hua's life and accomplishments have been authoritatively presented in Wang Yuan, *Hua Loo-Keng*, Singapore: Springer 1999.

[5] On the movement of scientists between China and US, see Zuoyue Wang, "Transnational Science during the Cold War: The Case of Chinese/American Scientists", *Isis* 2010(2), p. 367–377.

[6] Hua became the director of the Preparatory Office for IMCAS in 1951; IMCAS was formally established on July 1, 1952. On the development of IMCAS, see Wang Yuan, *Hua Loo-Keng*, and Jiri Hudecek, *Reviving Ancient Chinese Mathematics: Mathematics, History and Politics in the Work of Wu Wen-Tsun*, (London: Routledge 2014), p. 40–65.

[7] "Di yi jie Quanguo renmin daibiao da hui di san ci huiyi de jueyi 第一届全国人民代表大会 第三次会议的决议" [Resolution of the Third Plenary Session of the First National People's Congress], *Renmin ribao*, July 1, 1956, p. 2.

[8] Chen Dequan 陈德泉 and Ji Lei 计雷, "Cong Hua Luogeng jiaoshou de tongchou fa youxuan fa tanqi 从华罗庚教授的统筹法优选法谈起" [Starting from OPM and OSM of professor Hua Loo-Keng], in *Tiejin renmin de shuxuejia Hua Luogeng*, 9–14, p. 10.