Between Philosophy and Mathematics: General Trends in Dissemination, Teaching, and Research on Mathematical Logic in 1930s China

*Jan VRHOVSKI**

Abstract

This article studies some central developments in the propagation and teaching of mathematical logic in 1930s China. Focusing on the emergence of a twofold disciplinary approach to mathematical logic, namely as a discipline studied and disseminated by Chinese philosophers on the one hand and mathematicians on the other, this paper explores one of the key turning points in the development of the academic notion of mathematical logic in China. Apart from casting some light on the teaching of mathematical logic in the framework of both philosophical as well as mathematical spheres of inquiry, this article also provides some preliminary insights into the circumstances surrounding the first systematic introduction of mathematical logic into the modern standardized system of education, which gradually took shape over the late-1920s and early 1930s in China.

Keywords: mathematical logic, mathematics, philosophy, China, Republican Period

Med filozofijo in matematiko: splošne težnje v širenju, poučevanju in raziskovanju matematične logike na Kitajskem v 30. letih 20. stoletja

Izvleček

Članek preučuje osrednje razvojne smernice v širjenju in poučevanju matematične logike na Kitajskem v 30. letih 20. stoletja. Osredotočen na pojav dveh različnih znanstvenih pristopov k matematični logiki – namreč kot disciplini, ki so jo preučevali in širili kitajski filozofi na eni strani ter kitajski matematiki na drugi – nadalje preučuje eno izmed osrednjih točk obrata v razvoju matematične logike kot akademske discipline na Kitajskem. Poleg tega, da pojasnjuje, kako se je predmet poučevalo v sklopu tako filozofskih kot tudi matematičnih raziskav, članek prav tako podaja nekaj preliminarnih vpogledov v okoliščine, ki so obdajale prvi sistematični poskus vključitve matematične logike v moderni standardizirani sistem izobrazbe, ki je postopoma nastajal na Kitajskem v 20. in 30. letih 20. stoletja.

Ključne besede: matematična logika, matematika, filozofija, Kitajska, republikansko obdobje

* Jan VRHOVSKI is currently working as a research fellow at the Faculty of Arts, University of Ljubljana.
Email address: jan.vrhovski@ff.uni-lj.si

Introduction

By the early 1930s, mathematical logic as a notion and field of study became an integral element of the efforts of nationalist government to modernize Chinese education both at the higher as well as the secondary levels. Catalysed by the efforts of a group of Chinese philosophers, educated either at foreign institutions or Chinese universities in the centre of intellectual modernization in the 1920s, mathematical logic as a subject of teaching and research became established as one of the central pillars of modern philosophical studies as early as in the late 1920s. By the early 1930s, as a widely renowned paragon of university-level curricular reformation, the Department of Philosophy at the reformed National Qinghua University (*Guoli Qinghua daxue* 國立清華大學, official English name Tsinghua University) became the first centre of teaching and research in mathematical logic nationwide, prompting the start of a new wave of dissemination and advancement of mathematical logic in Chinese academia.

This article represents a follow-up to one of my previous publications entitled "'Qinghua School of Logic': Mathematical Logic at Qinghua University in Peking, 1926–1945" (Vrhovski 2021a), which surveyed the development of teaching and research of mathematical logic at Qinghua University in the late-Republican period. The main aim of this article is to supplement the results of this earlier article by presenting a more general overview of the development of mathematical logic as a subject of teaching and research in 1930s China. In the course of following discussion, these developments will be presented through the prism of two contending currents of approach towards studying and teaching mathematical logic that formed by the early-1930s: that is, mathematical logic as a part of Chinese academic philosophy on the one hand, and mathematics on the other. With regard to their conceptual extensions—i.e. as the constituents of broader theoretical discourses of both respective disciplines—the distinction between these two currents shall be referred to as the philosophical and mathematical "notions" of mathematical logic. The main reason behind introducing such a distinction resides in the fact that, for the most part, the advancement of the latter had been conducted in the context of the wave of popularization of mathematics in the 1930s. More importantly, the application of a conceptual disparity of this kind can serve as an ample explanation for the relatively rapid "mathematization" of mathematical logic which took place in Chinese academia in the early 1950s. Thus, in the broadest sense, in line with the above-mentioned article on the so-called "Qinghua School of Logic", this study will provide a background for the subsequent surveys on the development of mathematical logic in the People's Republic of China (1949–). Aside from a brief overview presented by Rafael Suter

(2020) in his contribution to the *Dao Companion to Chinese Philosophy of Logic* and specific sections of Xu Yibao's doctoral dissertation from 2005, this study will be one of the first such contributions to the Western scholarship on the history of logic in Republican China. Furthermore, it will be first study highlighting the parallel development of mathematical and philosophical notions of mathematical logic in this context.

The Ariadne's thread of the following discussion will interconnect three main parts: In the first chapter I will take a closer look at teaching and research in mathematical logic in the context of philosophical departments at Chinese universities. Because the main features, directions, and achievements of the Qinghua School have already been discussed in detail in the above-mentioned article, only a brief summary of the developments at Qinghua will be given, while the main focus of the chapter will reside with the developments at other universities of similar status, including Peking University and the reformed National Wuhan University, and finally also the gradual introduction of essentials of mathematical logic in the modernized and standardized textbooks for higher secondary schools, normal schools and universities. Correspondingly, the second chapter will closely examine the development of mathematical logic in the context of Chinese mathematicians' research and efforts at popularizing mathematical logic in the 1930s. Finally, the third and the last section will be reserved for concluding remarks and a brief analysis of the value of the main findings of this survey for our understanding of the following period of mathematical logic.

Mathematical Logic as Part of Academic Philosophy: From Qinghua to Wuhan University

As already mentioned in the introduction, mathematical logic as a part of academic discipline of philosophy reached its full bloom in the progressive environment of the Department of Philosophy at Qinghua University. In the framework of the flourishing of modern Western philosophy at the department, mathematical logic became one of the pillars of both undergraduate and later also graduate studies of philosophy. As such, mathematical logic as formulated in the works of Bertrand Russell and his and Whitehead's monumental *Principia Mathematica* was taught as part of the basic and advanced courses on logic both at the level of the institute of humanities and specialized studies in philosophy. Apart from its early inclusion into the mandatory and selective courses on logic, from the late-1920s on mathematical logic was also one of the main research foci of the leading senior members of the department, such as Jin Yuelin 金岳霖 and Zhang Shenfu 張申府. Concurrently with the formation of the first generations of graduates specialized in logic, mathematical logic also became one of the leading specializations of those alumni of the department who either continued their studies at Western universities or upon graduation joined the department as junior lecturers—such as, for instance, Shen Youding 沈有鼎 and Wang Xianjun 王憲鈞. While at the earliest stage the style and content of teaching of mathematical logic at Qinghua University was more or less epitomized in Jin Yuelin's renowned textbook *Logic* (*Luoji* 邏輯), the later generation of Qinghua-trained logicians ushered in a wider selection of contents from contemporary advances in European circles of modern logicians. Thus, by the mid-1930s the range of content relating to mathematical logic taught at the department included: the system of *Principia*, advances of the "Harvard School" of symbolic logic, symbolic logic as advanced by the members of the Vienna Circle—from Carnap to Gödel, down to theories of many-valued logic of the Polish Circle of modern logicians. In line with the general trends in the field, as still extant in Western academia in the 1920s and 30s, mathematical logic at Qinghua was taught in strict cohesion with analytic philosophy, in particular, and in direct connection with traditional and modern Western philosophy, in general. In other words, mathematical logic was more or less considered as an advanced form of traditional formal logic, which still shared the same disciplinary framework with its predecessor. (See Vrhovski 2021a)

From the early 1930s on, the influence of the Qinghua School of Logic and its slowly growing circle of analytic philosophers extended far beyond the university. After the former student and propagator of Russell's philosophy Fu Tong 傅銅 rejoined the reopened Peking University as the head of the Department of Philosophy in 1929, interest in modern logic and analytic philosophy was gradually rekindled at the department. Consequently, in addition to the advancement of a special study group for logic (*lunlixue zu* 論理學組) in the framework of the Philosophical Research Society (*Zhexue yanjiuhui* 哲學研究會) (see Guoli Beijing daxue 1929, 68), his strong inclination towards modern Western philosophy probably also prompted a new wave of integration of courses on analytic philosophy and mathematical logic into the basic curriculum at the department. Subsequently, in the early 1930s, the undergraduate and graduate students of philosophy at Peking University were able to attend a series of lessons given by professors from the neighbouring Qinghua University, from Zhang Shenfu's introductory course on mathematical logic and Russell, to Jin Yuelin's specialized lectures on Mill, epistemology and so on. In this regard, the developments relating to the teaching of mathematical logic at Beijing's most prestigious universities had their epicentre at the early studies of Western modern logic and philosophy at Qinghua University.[1]

The second important wave of spreading the Qinghua-type of teaching of mathematical logic at Chinese universities came with the first generations of graduates of the Qinghua philosophical department, or in rarer cases through the work of scholars who had in any way been affiliated or in touch with the developments at Qinghua. Naturally, in parallel with the spread of the Qinghua Circle's influence by means of personal ties and fostering a new generation of outstanding Chinese scholars, the dissemination of the notion of mathematical logic as taught and researched at the department was to a much larger degree conducted by means of publications, which included research treatises and propaedeutic articles on one side, and the dissemination of certain types of textbooks on the other. Apart from Peking University, another instance of the introduction of content related to mathematical logic by an alumnus of the Qinghua school was the reformed National Wuhan University (*Guoli Wuhan daxue* 國立武漢大學).

National Wuhan University was officially established in 1928. It was founded as an attempt to combine a number of smaller institutions of higher education from Hubei, including the recently established (1926) National Wuchang University (*Guoli Wuchang daxue* 國立武昌大學), into one major and modernized university. Owing to its relatively late establishment, and through the influence of a the newly rising tide of modernization of Chinese academic philosophy, the earlier National Wuchang University already boasted a relatively theoretically pertinent and updated curriculum for logic. In the framework of the Wuhan University's Department of Philosophy, the first major advance towards a modernized course in logic came in the year with the appointment of Tu Xiaoshi 屠孝實 (courtesy name Zhengshu 正叔, 1898–1932) as a lecturer of logic (Guoli Wuhan daxue 1931, 73, 82). Tu was a graduate of Waseda University in Tokyo and a former professor of philosophy at Peking University, who in 1926 wrote and published the highly influential textbook *Logic Primer* (*Mingxue gangyao* 名學綱要), which also encompassed a short introduction to early algebraic logic (Boole and De Morgan) based on Jevons' *Elementary Lessons on Logic*.

In 1932, Tu was replaced by Wan Zhuoheng 萬卓恆 (1902–1948), a graduate of philosophy from Qinghua and Harvard Universities. Prior to his tenure at Wuhan University, Wan taught philosophy at the North-Eastern University. During his professorship at Wuhan, between 1931 and 1948, Wan was generally known

1 On the earlier developments in teaching and propagating modern logic at Peking University, see Vrhovski (2021b). On development of the academic discipline of Chinese philosophy at Chinese universities in the 1920s and 1930s, see Lin (2012), etc.

as a lecturer of logic who specialized on mathematical logic.[2] Wan's reputation as a professor of philosophy who understood mathematical logic and lectured about *Principia Mathematica* extended beyond the circle of professors and students at the university. Even though Wan did not produce any writings related to mathematical logic or even logic, he is mentioned in some contemporary Chinese histories of modern logic in China as one of those philosophers from Republican China who were engaged in teaching and spread of mathematical logic.[3] Beside logic (*lunlixue*), Wan also taught other courses related to contemporary Western philosophy and epistemology. The official overview of courses and programs at the National Wuhan University from 1932 reveals that the first course on logic organized by Wan had already assumed a modern outlook. The content of Wan's lectures from 1932 covered the following topics: various problems in formal logic, forms of deduction and contemporary logic (Guoli Wuhan daxue 1932, 23). In the following years, apart from an elementary course Wan also organized an advanced course on logic (called "Logic 2, Lunlixue er 論理學二"), which was offered as an elective course for students of philosophy. In 1934, the elementary course was devoted exclusively to an overview of Aristotelian logic and aimed at presenting a general outline of the principles of human thought and the idea of correct thinking. The advanced course, on the other hand, consisted of three main parts: Aristotelian logic, symbolic logic (mathematical logic) and theory of induction (Guoli Wuhan daxue 1934, 26–27, 33). According to the reminiscences of Wan's former student Xiao Shafu (萧箑父, ?), the part of the lectures related to symbolic logic revolved exclusively around the *Principia Mathematica*, covering the parts about the basic principles and logical calculi (Xiangren 2017, 26). The content of the elementary course changed again in 1936, when it was reorganized to include 1) formal logic and 2) the scientific method, while the content of the advanced course remained unchanged (Guoli Wuhan daxue 1936, 33, 40). In the same year, two elementary textbooks were prescribed: beside the by then already standard textbook *Essentials of Logic* by Wolf, there was also *Logic* (*Lunlixue* 論理學 (1931)), written by Fan Shoukang 範壽康 (1895–1983), another professor of philosophy at Wuhan.[4]

---

2 Beside He Lin's mention of Wan as one of the leading contemporary Chinese philosophers who specialized in mathematical logic, there are also accounts and reminiscences of his former students, most notably the philosopher Xiao Shafu. See Li Mianyuan (2016); Li Weiwu (2009); Xiangren (2017).

3 See, for example, Shi and Zeng (1998, 29–33).

4 The textbook was published as a part of *Kaiming Pedagogical Textbooks* (*Kaiming shifan jiaoben* 開明師範教本). It was designed in accordance with a psychological approach to logic (logical psychologism), which favoured the experimental logic of American pragmatists above other types of modern logic. As a matter of fact, even though in his historical introduction Fan did mention

Mathematical Logic as a Mathematical Field of Research: The Wuhan Circle of Mathematicians

As indicated in the introduction, before the 1930s mathematical logic was still generally understood as a field of studies researched by, so to say, "philosophers-logicians". This also meant that the predominant notion of mathematical logic in the Chinese intellectual world was still understood in the context of modern Western philosophy. However, this understanding underwent significant changes in the early 1930s, when a few young mathematicians who returned from their studies in Europe decided to engage in research of the foundations of mathematics and mathematical logic. One of the most important centres for the concentration of such interest in mathematical logic was the aforementioned Wuhan University. After Fu Zhongsun's 傅種孫 and Zhang Bangming's 張邦銘 translation of Russell's *Introduction to Mathematical Philosophy* in the early 1920s (see Russell 1922), the following developments represented the first major shift of identity of mathematical logic in China, which in the 1930s started its twofold evolutionary path. One of the young scholars who was at the forefront of this transformative process was the mathematician Tang Zaozhen 湯璪真 (Tang Tsao-Chen, 1898–1951). Tang, who completed his graduate studies in mathematical logic at the Universities of Berlin and Göttingen, became the main driving force behind the research on mathematical logic at the mathematical department of Wuhan University. The importance of Tang Zaozhen and the circle younger mathematicians at Wuhan University has already been noticed by Xu Yibao (2005), who briefly mentioned Tang in his doctoral dissertation *Concepts of Infinity in Chinese Mathematics.* He wrote:

> After graduating from Department of Mathematics of Beijing Teachers College in 1919, TANG taught mathematics at Beijing Teachers College for Girls. In late of 1923, he went to Germany to pursuit his further study in mathematics. During the next two and a half years, Tang studied

mathematical logic or symbolic logic of Boole as one of the mainstream currents in contemporary logic, it was only a brief mention, ignoring all its main contributors who succeeded Boole. Moreover, he treated mathematical logic as a less important branch of the formalist school in philosophical logic, and instead devoted more attention to idealist conceptions of logic. Fan also regarded the pragmatist logic of Dewey as one of the most important logical schools of the time, which contented against logic formalism, as manifested in mathematical or symbolic logic (Fan 1931, 1–26). One of the immediate consequences of his view of logic led Fan to exclude the most important contemporary contributions to theory of deduction from the textbook. Instead, Fan's outline of the science of reasoning derived its broadness from the inclusion of a great number of metaphysical and phenomenological meditations on logic. Thus, for example, beside deductive and inductive reasoning, he also discussed the notion of analogical reasoning (*leibi tuilun* 類比推論) etc. The textbook also maintained a notion of Chinese logic as reflected in traditional Chinese philosophy.

> primarily differential geometry and mathematical logic at University of Berlin and University of Göttingen. When he returned in 1926, he was appointed as Professor of mathematics at National Wuchang University (the predecessor of Wuhan University). At the University, he used Wilhelm J. E. Blaschke's textbook for teaching his course on differential geometry. Mathematical logic was not on the curriculum of the University, but TANG did not lose his interest in it. Although his focus was on Clarence Irving Lewis's calculus of strict implication, and was not directly related to aspects of the infinite, it does show how quickly Chinese mathematicians began to respond to this new area for their own research. TANG published three articles on the subject in the *Bulletin of the American Mathematical Society.* In the first of these, "The Theorem $p - 3q = pq = p$ and Huntington's Relation Between Lewis's Strict Implication and Boolean Algebra," he shows that the theorem "$p - 3q = pq = p$" holds true in Lewis's system, and that it strengthens a previous result of Edward Huntington. Based on this result, TANG went on to show that where any implication "$p - 3q$" is asserted, then "$p - 3q = i$," from which it follows that any two asserted implications are strictly equivalent, and, in particular, that any two of Lewis's first eight postulates can be deduced from each other. TANG also studied algebraic postulates for Boolean rings. (Xu 2005, 189–90)

As pointed out by Xu, Tang's main contribution to mathematical logic consisted in his treatment of Huntington's discussion of Lewis's theory of strict implication and the theorem "p ⥽ q .=. $pq = p$". Although Xu's account of Tang's main contributions to mathematical logic is close to complete, some additional points related to Tang's work must still be added. Firstly, we need to point out that Blaschke's differential geometry was one of the central subjects of Tang's studies in Germany. Apart from mathematical logic, in the early 1930s Tang also focused on other branches of mathematics, such as for example, Levi-Civita's absolute differential calculus, which he also translated into Chinese (Cheng Minde 1994 I, 60–71). Tang's translations also included Hans Hahn's "Set-Theoretical Geometry", which was first published in 1930 in the *Quarterly Journal of Science of the National Wuhan University* (*Guoli Wuhan daxue like jikan* 國立武漢大學理科季刊). Secondly, according to the biography composed by his son Tang Xiangsen 湯湘森, Tang researched mathematical logic throughout the entire wartime period. If this is true, the same or similar could also apply to the research activities of the group of mathematicians working closely with Tang (ibid., 68). Unfortunately, no textual evidence is preserved to confirm these claims. Finally, Tang was also one of the founding members of the Chinese Mathematical Society. From its official inauguration in 1935, Tang assumed a series of important positions in the society—he was one of its 21 council members elected in 1935 and a member of the society's executive council in 1936 (Ren and Zhang 1994, 30, 52). At the second annual meeting of the society, which took place at Qinghua Science Museum in 1936, Tang also read his two articles on strict implication, published in the same year in the *Bulletin of American Mathematical Society*. Thus, together with Zhu Gongjin—about whom we shall say more in the next section—Tang was one of two most important members of the society, who maintained an interest in contemporary mathematical logic and contributed to its advancement in Chinese mathematical circles. Interestingly, both Zhu and Tang had studied mathematics at Göttingen University in Germany, although only the latter contributed scientifically to the field. Furthermore, in the 1930s both participated in activities related to science education. Tang was also invited to take part in the 1933 consultative symposium on astronomy, mathematics and physics organized by the Ministry of Education.

Another Wuhan mathematician, who (probably under the influence of Tang Zaozhen) engaged in research on topics related to mathematical logic, was Xiao Wencan 蕭文燦 (1898–1963), an assistant professor of mathematics at Wuhan.[5] Xiao started his path in higher education at the Guizhou Province Normal College in Guiyang (graduating in 1916). In 1921, he enrolled in Wuchang Higher Normal College (predecessor of Wuhan University), majoring in mathematics. Upon graduation in 1925 he joined the university as a lecturer in mathematics. Concurrently, he also worked as a lecturer of mathematics at the China University. Later, in 1937, he went on a scholarly exchange to Germany, where he studied consecutively at the Universities of Berlin and Leipzig. Xiao returned to China in 1940, after he was awarded a doctoral degree in mathematics from University of Leipzig. Working under Tang Zaozhen, back in the early 1930s, Xiao Wencan also devoted a part of his work to problems related to mathematical logic, more precisely to Cantor's transfinite set theory.[6] Between 1933 and 1934, Xiao published a series of articles entitled "Set Theory (Jihelun 集合論)" in the university's *Quarterly Journal of Science*, in which he delivered a systematic introduction to Cantorian set theory. The collection of Xiao's four articles on set theory was reprinted in the form of a monograph (*Jihelun chubu* 集合論初步 (*Elementary Set Theory*)) in 1939. In the same journal Xiao also published a Chinese translation

5 For a condensed biographical account on Xiao Wencan, see Li and Xiao (2005).

6 Xu Yibao and his doctoral supervisor Joseph Dauben claim that Xiao was the first Chinese mathematician to have provided a systematic overview of Cantor's set theory (Xu 2005, 200; Dauben 2002, 267).

of Hardy's work "Orders of Infinity (Wuqiongda zhi jie 無窮大之階)".[7] In his dissertation, Xu Yibao commented on Xiao Wencan's and Zhu Gongjin's contributions to the propagation and spread of mathematical logic in the following way:

> Xiao's and Zhu's articles, together with Chinese translations of Russell's work, kindled further interests in mathematical logic in China. As a result, in the 1930s a number of Chinese students of mathematical logic were able to carry out their own research. By the time TANG Zaozhen's third article was published in America, another Chinese student had written his dissertation on mathematical philosophy and the theory of sets at the University of Paris. This was ZENG Dinghe 曾鼎鉌, also known as TSENG Ting-Ho.[8] The major parts of ZENG's thesis dealt with set theory and transfinite numbers. In retrospect, one may regard ZENG's thesis as superficial and sketchy.[9] It nevertheless represents the beginning of serious and important work that Chinese logicians would soon make to mathematical logic. (Xu 2005, 200–1)

Although Xu's summarization of Xiao's contributions is somewhat biased, he might have made a pertinent remark regarding mathematical logic as a subject studied by Chinese mathematicians. Furthermore, the contributions by Xiao and Zhu, which must be regarded as introductory works or attempts at the popularization of mathematical logic and set theory as one of its constitutive branches, could indeed have been pivotal for kindling the Chinese mathematician's interest for the above-named fields of studies, especially because they both purported to convey their mathematical content rather than philosophy-related categories.

7 Xu (2005, 200) mistakenly believed that Xiao's two articles were authored by Xiao himself. In truth, they were a translation of above-named work of the British mathematician Hardy. In addition to that, Xu also noted that the notion of infinity was of great interest to Chinese mathematicians of the time (see Hardy 1932; 1933).

8 His name was also written 曾鼎龢 (Zeng Dinghe). In 1938 Zeng was awarded a PhD degree for a doctoral dissertation entitled "La philosophie mathématique et la théorie des ensembles (Mathematical Philosophy and Set Theory)"; see Tseng 1938.

9 This were the exact words of Frederic B. Fitch, who reviewed Zeng's doctorate in 1943 (*The Journal of Symbolic Logic* 8 (2) (June 1943): 56–57). Fitch said: "This is a philosophical and historical survey of various topics in modern mathematics, such as set theory, probability, transfinite numbers, and mathematical logic. The treatment is somewhat sketchy and often superficial. In discussing mathematical logic no mention is made of Gödel, although literature as later as 1936 is referred to." (Fitch 1943, 56) Zeng's doctorate was listed in the bibliography of Bernays's and Fraenkel's 1958 book *Axiomatic Set Theory* (although the latter wrote only the introductory parts and provided some bibliographical data). Consequently, in his letter to Bernays from March 14th, 1958, Gödel inquired about the content of Zeng's work: "Ich habe bemerkt, dass Sie in Ihrem neuen Buch über Mengenlehre einen gewissen Tseng[g] Ting-Ho zitieren. Ist diese Arbeit interessant? (I noticed that in your new book on set theory you cite a certain Tsen[g] Ting-Ho. Is that paper interesting?)" (Gödel and Solomon 2014, 152)

Mathematical Logic and the Popularization of Mathematics: Zhu Gongjin and Hilbertian Foundations of Mathematics and Mathematical Logic

Another important Chinese mathematician, who to some extent contributed to the introduction and propagation of mathematical logic as a branch of mathematics in China, was the well-known educator and popularizer of mathematics Zhu Gongjin 朱公謹 (also known as Zhu Yanjun 朱言鈞, 1902–1961). Zhu started his pursuit of mathematical knowledge at Qinghua College, where he completed the basic preparatory course. In 1921, he was awarded a scholarship for undergraduate studies at the renowned Göttingen University in Germany. In the years he subsequently spent in Göttingen, Zhu eventually specialized in applied mathematics and was in 1927 awarded a doctoral degree in mathematics for his thesis on the theory of differential equations, entitled *On Existence Proofs of Certain Types of Single-Variable Functional Equations*. After he returned to China in 1927, he worked as a professor of mathematics at Guanghua University, Central University, Shanghai Medical School, Normal Faculty of Zhejiang University, Datong University and Shanghai Jiaotong University. With the establishment of Chinese Mathematical Society in 1935, Zhu became one of its permanent council members and one of the most productive contributors to its periodical publications the *Shuxue tongbao* 數學通報 (*Bulletin of Mathematics* or *Bulletin des Sciences Mathematics*) and the *Shuxue zazhi* 數學雜志 (*Mathematical Review*) (Zhang Youyu 1991, 2).

Although Zhu spent almost seven years at the University of Göttingen in Germany and obtained a PhD in mathematics studying under two of the most famous and well-established mathematicians of the time, David Hilbert and Richard Courant, upon his return to China he ended up working at relatively marginal universities, such as Guanghua University and Jiaotong in Shanghai, although also at some more prominent universities, such the Central University in Nanjing. Although his direct influence on the theoretical development of mathematics in China seems to be (at least in when it comes to documentation) somewhat obscured by the marginality of the institutes of his employment, in the late 1920s and 1930s Chinese intellectual world his voice was loud and clear. Zhu was probably the most prolific popularizer of general and specific aspects of mathematics in early 1930s China. His numerous articles introducing different aspects and problems of advanced mathematics (especially analysis), philosophy of mathematics and finally also his translations of writings by important mathematicians like Dedekind or Hilbert, were not only published in university-affiliated periodicals, such as the *Shuxue zazhi* 數學雜志, but also in magazines devoted to popularization of Western science.[10] It was especially the latter that established his role as a popularizer of applied mathematics in China.

Among Zhu's articles introducing various topics, theories or branches of mathematics, there were also some that explicitly or implicitly involved the principles of contemporary mathematical logic. Two of the most influential such articles were "An Introduction to Mathematical Logic (Shuli luoji daolun 數理邏輯導論)" from 1936 and "Essentials of Mathematical Logic (Shuli luoji gangyao 數理邏輯綱要)" published in two parts in 1933 and 1934. Although the articles only expounded on a rather elementary notion of mathematical logic, their significance lay in another aspect: because Zhu was introduced to mathematical logic as a mathematician, he regarded its content to be primarily a part of mathematics. Consequently, his articles usually implicitly indicated that the research on mathematical logic ought to be reserved exclusively for mathematicians. As such, introductions to mathematical logic or set theory done by mathematicians were of a different value to those done by philosophers, for they each derived from different theoretical or practical contexts and ultimately also influenced separate academic spheres of discourse.

As an ardent popularizer of mathematics who also maintained a considerable interest in mathematical logic and the foundations of mathematics, Zhu often also wrote articles commenting upon the relationship between mathematics and logic on one side, and modern philosophy on the other.[11] More importantly, a

10 For the general significance of translations—and for highlighting some general problems linked to translations of Western vocabulary—see for instance Ciaudo (2021, 36).

11 Zhu's earliest publications on philosophy of mathematics were a series of articles written in response to contemporary misinterpretations of the nature of mathematics, proposed by Chinese adherents of pragmatism who propagated Dewey's experimentalist theory of logic and science. In 1928, in an article entitled "A Refutation of Experimentalism (Bo shiyan zhuyi 駁實驗主義)", Zhu emphasized that mathematical knowledge is *a priori* and as such a formal expression of the unchanging principles of the universe. What Zhu argued against was the experimentalist position that the universe is subjected to constant change and that the main task of science is to constantly realign itself with the current state of the universe. In order to corroborate his position, Zhu used the example of ontologically positive concept of logical laws, which are manifested in axiomatic systems of mathematics. As examples thereof he listed three axiomatic (*jiben yuanli* 基本原理) systems of geometry as developed by Euclid, Riemann, and Lobachevski. Having expounded on the concepts of consistency and non-contradiction as concrete examples of the application of logical laws in mathematics, he explained the difference between different kinds of judgments as defined by Kant, shedding some light on the epistemic value and sufficient conditions of the truth of mathematical axioms. In short, Zhu's principal aim was to portray the objectiveness of logic, as the main condition of mathematical truth, through a system of laws reflecting the *a priori* structure of reality. This implies that mathematical judgements and inferences are beyond experimental inquiry and that mathematical judgments were *a priori* synthetic judgments. In a sequel to the article, Zhu directed his criticism against the philosophical viewpoints of Hu Shi and Dewey. Similar was

closer reading of his philosophical writings on mathematics and modern logic reveals that one of his principal sources was the teaching of the leading mathematical formalist of the time, David Hilbert. As noted above, Zhu's connection to Hilbert's mathematical and logical formalism can be traced back to the former's studies in Göttingen. Consequently, one of the main parts of Zhu's popularization of modern mathematical logic also consisted of introducing the work of Hilbert. Thus, for example, in an article published as early as 1929 Zhu discussed the differences between Brouwer's intuitionist "theory of sets" (*tuanlun* 團論) and Hilbert's formalist idea of contradiction (*ziweiyu* 自違語) in the same theory. Interestingly, Zhu discussed both schools as offshoots of two currents in mathematics, analogous to those in modern cosmologies which derive from advances in modern physics (see Zhu Yanjun 1929b). In another article from 1932, Zhu gave a lengthier exposition on Hilbert's life and his theory of axiomatics (*yuanlishuo* 原理說), axiomatization of arithmetic, as well as other aspects of Hilbert's views on questions related to the fundaments of mathematics, some of which were also intrinsically linked to mathematical logic (see Zhu Yanjun 1932, 2–8). Finally, in 1935 Zhu published an updated version of his evaluation of intuitionism and formalism. In this sequel to his first such mediation from 1929, Zhu focused both on set theory and theories of inference in mathematics, covering three main topics: Poincare's view on mathematical inference and set theoretical questions, the rise of intuitionism and Russell's mathematical logic. The main topic of Zhu's second survey was still Hilbert's views on axiomatization of mathematics. Zhu's writings on the foundations of mathematics from this period reveal that his views on the subject remained within the constraints of Hilbertian theory, which he came into contact with during his studies in Germany. He did not discuss, for instance, the developments in the Polish School of Logic or, most importantly, Gödel's results related to the above-mentioned problems and topics. Even in his "Critiques of Mathematical Axiomatics (Shuxue yuanlixue zhi piping 數學原理學之批評)" from 1937, the primary aim of which was to outline criticisms raised against Hilbert's project of axiomatization of mathematics, Zhu made no mention of these important contemporary contributions.

In the early 1930s, Zhu edited a series of short discussions on practical or purely theoretical curiosities of mathematics, which was regularly published in the *Guanghua daxue banyuekan* 光華大學半月刊 (*Guanghua University Fortnightly*).

intended also in Zhu's other writings from the late 1920s, such as, for example, "New Geometry and Philosophy (Xin jihexue yu zhexue 新幾何學與哲學)"; "From Theory of Knowledge to Critical Theory (Cong renshilun dao pipinglun 從認識論到批評論)"; "On the Relationship Between Metaphysics and Natural Science (Xuanxue yu ziran kexue de guanxi 玄學與自然科學的關係)", and "Socrates and Leonard Nelson (Sugeladi yu Na'ersong 蘇格臘底與納爾松)", which were all published in 1929.

These discussions were subsumed under a common title "Shuli congtan 數理叢談 (Mathematical Discussions)", and by the year 1934 the number of individual discussions already reached twenty.[12] Furthermore, in 1936 Zhu published yet another series of writings introducing the advances in foundations of mathematics and mathematical logic in the above-mentioned periodical. The series bore the title "Casual Conversations on Set Theory (Jilun xiaotan 集論小談)", and was written in form of a dialogue between Zhu and a colleague of his, who was also a professor of mathematics (see Zhu 1936c; 1937b (first and last part)). Through dialogues Zhu touched upon various questions related to the recent advances in foundations of mathematics. Perhaps the most important feature of these conversations was that they were written from the mathematical perspective—treating set-theoretical problems and mathematical logic as an integral part of mathematics, which, as also pointed out by Zhu himself, had been often entirely neglected (see Zhu 1936c, 28). Even though the title of the conversations implies a sense of casualness and elementariness, the dialogues also touched upon more advanced topics in set theory, mathematical logic and even number theory, all of which were bound together in meta-mathematics of Hilbert. The conversations were published in ten parts between 1936 and 1937.

In 1935 and 1936, Zhu also published a series of other propaedeutic articles on topics related to the foundations of mathematics and mathematical logic. Such were, for example, the series of articles entitled "Methods of Inference in Mathematics (Shuxue zhong zhi tuili fangfa 數學中之推理方法)". Other relevant articles from the same period were "The Origins of Mathematical Knowledge (Shuxue renshi zhi benyuan 數學認識之本源)", "Topological Geometry and Our Views on Space (Dingxing jihexue yu wuren zhi kongjian guan 定性幾何學與吾人之空間觀)" and so on. The common thread interconnecting the majority of his writings from 1930s was again Hilbert's theory of foundations of mathematics (axiomatics, geometry, arithmetic, set theory). Whenever Zhu required the assistance of more philosophical views on mathematical principles he resorted to philosophy of Leonard Nelson, one of his former professors at university in Göttingen and a close friend of Hilbert's. In 1928, one year after he had returned to China, Zhu even published a short booklet commemorating Nelson's life and work.[13]

12 Eight of these chapters were also published in form of a book in 1947.

13 Nelson passed away in 1927. The mentioned booklet bore the title *Nelson—A Philosopher of Critical Rationalism (His Life and Teaching)* (1928c).

Introduction of Mathematical Logic of Hilbert and Ackermann, 1933–1936

Zhu's pivotal contribution to the introduction of Hilbertian symbolic logic in China took form in two lengthier articles outlining the essential concepts of mathematical logic. The first article, entitled "Essentials of Mathematical Logic (Shuli luoji gangyao 數理邏輯綱要)", was published in 1933 in the *Zhexue pinglun* journal. Here, Zhu's approach to mathematical logic was similar to his other publications: he essentially described mathematical logic as a version of formal logic which assimilated the most advanced knowledge from mathematics. Moreover, Zhu mainly ascribed its advantages to the advances in modern mathematics; in particular, its use of symbols and formulae, which endowed logic with a capacity to attain completeness, consistency, and a greater analytical capacity. Even though his short overview of the history of mathematical logic mentioned all the important contributors to the field, from Leibniz to Russell, Zhu's focus remained with Hilbert, who, according to Zhu, was able to include the most advanced principles of mathematics into his logic. While Zhu did not explicitly indicate this, the content of the article derived heavily from Hilbert's and Ackermann's *Grundzüge der theoretischen Logik* (1928).[14] As a matter of fact, some parts of Zhu's "Essentials of Mathematical Logic" correspond entirely to individual sections of the 1928 edition of Hilbert's and Ackermann's *Grundzüge der theoretischen Logik*. Thus, Zhu's introduction to mathematical logic was in fact an introduction to the early Hilbert-Ackermann system of mathematical logic.

Zhu's article from 1933 covered the following aspects of the Hilbert-Ackermann system of logic: Propositional logic (*lunduan luoji* 論斷邏輯),[15] which included: a) the definition of proposition; b) methods of elementary connectives (*jiben jiehe* 基本結合);[16] c) equivalence (*dengshi* 等式); d) a further discussion on the elementary connective methods (including the Sheffer stroke, Russell, etc.); e) elementary forms (of logical expressions) (*jiben xingshi* 基本形式);[17] f) tautological (always true)

14 The first (1928) and second (1938) editions of the book differ considerably from each other. The first book builds upon Hilbert's formalistic first-order logic and still included the *Entsheidungsproblem* and the question of completeness of logic as a system, which were ultimately left out of the later edition. The second edition was also translated into English and given the title *Principles of Mathematical Logic* (1950).

15 Here the term *lunduan* 論斷, otherwise meaning "inference" or "judgment", stands for "proposition" or German *Aussage*, as in Hilbert's *Aussagenkalkül*.

16 Zhu's term *jiehe* 結合 is semantically motivated after the original German term *Verknüpfung* as in "logische Grundverknüpfungen" as used in Hilbert's and Ackermann's mathematical logic.

17 The original title of the section was "Normalform für die logischen Ausdrücke" (i.e. Section 1, Chapter 3 of the 1928 edition).

connections of propositions (*yongzhen zhi jiehe* 永真之結合);[18] g) the theorem of reciprocity (*huyixing zhi dingli* 互易性之定理);[19] h) the ever-false connections of propositions (*yongmiu zhi jiehe* 永謬之結合);[20] i) special elementary propositions (*teshu zhi jiben xingshi* 特殊之基本形式);[21] j) a further discussion on the question of conjunction (always true) and disjunction (always false); k) the problem of how to draw conclusions (*ruhe xia duan'an zhi wenti* 如何下斷案之問題).

As indicated above, the structure and content of Zhu's presentation of the essential features of mathematical logic corresponds to that of Hilbert's and Ackermann's book from 1928. As Zhu himself also noted in the 1933 version of the article, his source material was his notes from Hilbert's lectures, taken when he was still a student at Göttingen. Maybe the only parts of the text which Zhu decided to modify were the examples of propositions, which Zhu adapted to fit the Chinese socio-political context. The same article was reprinted in 1934 in the *Quarterly Journal of Science of the National Wuhan University* (*Guoli Wuhan daxue like jikan* 國立武漢大學理科季刊), which also happened to be one of the central means through which the group of mathematicians at Wuhan University promulgated their research, which in 1934 also encompassed set theory and the foundational, mathematical, and mathematico-logical theories of David Hilbert.[22]

Two years later, in 1936, Zhu published another article, "An Introduction to Mathematical Logic (Shuli luoji daolun 數理邏輯導論)", which represented a continuation of the article from 1933, where Zhu introduced the content of the remaining few chapters of the book by Hilbert and Ackermann. In this new article, however, Zhu's attitude towards logic changed slightly, at least in his manner of expression. This time, he compared mathematical logic to the method of "exhausting the principles" or "*qiongli* 窮理", a Neo-Confucian term which used to be linked to the Western concept of science. Zhu claimed that through logic one can extend already known laws to individual physical entities and distil the most fundamental principles of nature from known facts. In this context, mathematical logic represented the most advanced such method. He also remarked that mathematical logic takes the most elementary laws of science and translates them into relations between subjects and predicates, and between propositions.

18 Originally: "Charakterisierung der immer richtigen Aussagenverbindungen."

19 The original title of the section was "Das Prinzip der Dualität [The Principle of Duality]".

20 Originally "Die disjunktive Normalform für logische Ausdrücke."

21 This section appears to summarize chapter 7 of the first section in the original book, "Mannigfaltigkeit der Aussagenverbindungen, die aus gegebene Grundaussagen gebildet werden können."

22 Volumes 4 and 5 of the above-mentioned journal saw the publications of a Chinese translation of Hilbert's *The Theory of Algebraic Number Fields* by Hua Luogeng, a series of articles on "Set Theory" (Jihelun 集合論) by Xiao Wencan etc.

The 1936 sequel introduced two new chapters from Hilbert's and Ackermann's book. It was divided into two main chapters: "The Axioms of Propositional Logic (Lunduan luoji zhi yuanli 論斷邏輯之原理)" and "Main Ideas of Predicate Logic (Weici luoji zhong zhi zhuyao sixiang 謂詞邏輯中之主要思想)". In the first chapter Zhu summarized the content of chapters 10 and 11 of the first part of Hilbert's and Ackermann's *Grundlagen*.[23] At the same time, Zhu seems to have slightly departed from their original line of thought, for in his description the axioms from the *Principia Mathematica* are given the main role. He even added his own thoughts about the relationship between axioms of other branches of science and mathematical logic, where he maintained that mathematical logic represented a meta-scientific view of the axiomatic system, for it takes logical method as its main subject of enquiry. By being a meta-systemic science, it would thus be exempt from the rest of sciences, which must adhere strictly to the principles of the logical method and depend upon the consistency of their axiomatic fundaments (Zhu Yanjun 1936b, 85). The second part of Zhu's article summarized the introductory parts of the second section of Hilbert's and Ackermann's *Grundlagen* (1928).[24]

Gao Xingjian—"ABC of Mathematical Logic"

Significant contributions to the popularization of mathematical logic in 1930s China were also made by Gao Xingjian 高行健, a graduate in chemistry from the Central University (*Zhongyang daxue* 中央大學), a member of the National Institute for Compilation and Translation (*Guoli bianyi guan* 國立編譯館), and a professor of mathematics at Guiyang Medical University (–1948). As a prolific contributor to the journal *World of Science* (*Kexue shijie* 科學世界) he composed a series of articles on different topics from mathematics, mathematical games (*youxi shuxue* 游戲數學), interesting mathematical problems (*shuxue wenti* 數學問題), and new records of the most recent developments in mathematics (*jinnian shuxue zhi xin jilu* 近年數學之新紀錄), to more specific topics from the most fashionable branches of mathematics, such as mathematical logic. Gao also contributed a few articles to the famous *Kexue* journal, such as a short article on the Goldbach conjecture and some shorter articles on number theory.

For the present discussion, the most relevant of Gao's articles from the 1930s was his "ABC of Mathematical Logic (Shuli luoji ABC 數理邏輯ABC)" from 1936. The article aims to introduce the main concepts from mathematical logic to a

23 "Die Axiome des Aussagenkalküls" and "Beispiele für die Ableitung von Formeln aus den Axiomen."

24 Such as, for example, "Methodische Grundgedanken des Funktionenkalküls" etc.

more general readership. Most importantly, it attempts to do so by treating mathematical logic as a branch of mathematics. Gao was well-aware of previous introductions to Hilbert's and Ackermann's mathematical logic made by Zhu Yanjun. The main source of Gao's guide to the principles of mathematical logic was probably J. S. Turner's *Mathematical Logic* from 1928. A further interesting feature of the above-mentioned article was Gao's notion of mathematical logic, which he called the science of sciences, and science as such as an example of materialized logic. And a rather natural corollary to that position was that mathematical logic was the most advanced and modern example of this method. As the most important contemporary mathematical logicians Gao listed Russell and Hilbert, and enumerated the numerous synonyms for mathematical logic which were in use at the time. Otherwise, Gao's article was extremely concise and simple. The first part[25] covered three main topics: 1) Elementary Symbols, 2) Elementary Equations, and 3) Proofs of Elementary Equations.

Introduction of the Principles of Mathematical Logic into the National System of Education

Another important aspect of the establishment of mathematical logic in Republican China, and one of the most substantial direct outcomes of the developments described above, was its gradual inclusion into the new standardized secondary school, normal school, and university curricula. The beginnings of this inclusion can be traced back to the first bundle of reforms of the national system of education promulgated by the Nationalist government, whose aim was to unify and standardize education at Chinese schools and universities. Not long after the central government had moved to Nanjing (April 1927), the new Nationalist Ministry of Education began devising new plans for large-scale reforms of the national system of education. In so doing, it consulted various Western models, from the American "pragmatic" model of education, propagated by Hu Shi and his adherents, to French and German models of education. Subsequently, the first drafts of reforms were issued in the aftermath of the first national congress on questions of education in May 1928. The collection of documents issued following the National Congress on Education was epitomized in one titled "Reorganization of School System of the Republic of China (Zhengli Zhonghua renmin xuexiao xitong an 整理中華人民學校系統案)". In 1929, further documents stipulating new sets of regulations for institutes of higher education were issued—such as the

25 According to its title, Gao also planned to publish further parts of the article in the *Kexue shijie*. However, I was not able to ascertain the existence of any sequels to the 1936 article.

"Regulations for Universities (Daxue guicheng 大學規程)", "Organizational Law for Universities (Daxue zuzhifa 大學組織法)" and so on. These plans were revised at the Second National Congress on Education in 1930. Finally, new school laws for secondary, normal, and vocational education were promulgated again in 1932. The education system reforms in the Nanjing period of the Republic were not the first enterprise of this kind. In some respects, the first set of reforms, promulgated in 1922, were only continuing previous plans for modernization and standardization of the Chinese system of education[26] (see Pepper 1996).

Curricular changes, proposed in the framework of the National Congresses on Education of 1929 and 1930, were outlined in the *Curricular Standards for Junior and Senior Secondary Schools* (*Chuji gaoji zhongxue kecheng biaozhun* 初級高級中學課程標準 (1932)), and *Curricular Standards for Normal Colleges* (*Shifan xuexiao kecheng biaozhun* 師範學校課程標準 (1934)). These were published in several consecutive publications from 1932 on, and the manuals were revised in the early 1940s. For university curricula, there further existed a series of documents issued by the Ministry of Education entitled *List of University Courses* (*Daxue kemu biao* 大學科目表 (1940)). These started to appear in 1933, when an original draft version of the publication was published by the Commercial Press in Shanghai (Daxue kemu caoan 大學科目草案 (A Draft of University Courses)). In this draft document, the list of proposed standard courses at universities was supplemented by a list of prescribed literature.

Mathematical Logic in Senior Secondary Schools

The *Curricular Standards for Junior and Senior Secondary Schools* from 1932, which were based on the reform plans drafted and ratified by the Ministry of Education in 1929, stipulate that an introductory course on logic was to be taught in the final years of the senior secondary schools.[27] The prescribed content of the course "Logic (Lunli 論理)" covered the following topics:

- The Scope of Logic (essential characteristics, classification of logic, the relationship between logic and "other sciences").
- Analysis of Human Thought (the relationship between thought and life, the origin and development of thinking, organization of

26 For developments related to teaching of logic, see, for example, Zhai 2016, 59–63; He 1989, 75–106.

27 The chapter of the manual, entitled "Gaoji zhongxue lunli kecheng biaozhun 高級中學論理課程標準 (Standard Curriculum in Logic for Senior Secondary Schools)", was later also issued as an independent document.

thought, the difference between true and false thought, the difference between simple and complex thinking, the relationship between thought and writing).

- Essentials of Scientific Method (comparison between common sense and science, the aims and attributes of science, etc.).
- Induction (the concept of causality and critical review of the simple "five methods of induction", observation, analysis, conjecture, experiment and probability, the meaning and effect of scientific laws).
- Deduction (the new and old fields of induction ("old" refers to Aristotelian logic (*lunlixue* 論理學) and "new" refers to mathematical logic (*luoji* 邏輯), propositions (*ci* 辭) and propositional forms, relationships between propositions (kinds of immediate inferences and mediate inferences, syllogism), criticism of the old method of deduction, an exposition of the new method of deduction (analytical structure of thought, symbolist reformation of thought, strict form of thinking).
- System of Science (empirical science and pure science, natural science and social science, science and art, science, and philosophy).

As we can observe in the above outline of the content of the course on logic, at least in relation to the field of logic, the curricular reforms of the late 1930s embodied an extremely ambitious attempt to equip future university level students with basic knowledge about the scientific method on the one hand, and science of logic on the other. Furthermore, the new standard curriculum, which was drafted in the late 1920s and promulgated in the 1930s, was devised in a manner similar to the propaedeutic writings of Wang Dianji 汪奠基 which had been published in the first two years of the Nanjing period. As a matter of fact, the introduction of "new" mathematical logic into the curriculum might also have been indirectly facilitated by Wang's contributions to logic education and his ideas about how logic and the scientific method ought to be taught at different levels of education in China. Aside from that, the secondary school course on logic, as stipulated by the new standardized curriculum, conveys a certain evolutionary image of Western logic, where mathematical logic was not only treated as the only extant upgrade of the classic Aristotelian logic, but also a new version of logic, which ought to be used in everyday life. Because, through the relationship between old and new, the significance and usefulness of logic was not believed to shift from the quotidian to the scientific sphere, but rather to retain the same sense of universality throughout the entire process. This implied a view that knowledge about the patterns of the universe was also seen as pertaining to the sphere of its practical use in everyday life. Maybe the only feature of the curriculum which was critically aligned to the native discourse on the relationship between Western and Eastern thought was its strong emphasis on providing a clear delimitation between rational thought and the view on life.

The standard curriculum described above remained unaltered throughout the following decade,[28] until in the *Revised Curricular Standards for Junior and Senior Middle Schools* from 1942, when for some unknown reason the course "Logic" for senior middle schools was abolished in favour of more extensive courses on physics and chemistry (Ministry of Education 1942). Following the curricular reforms at secondary level of education, from 1928 on, a series of new standardized textbooks on logic started to emerge. In accordance with the new model, these textbooks apportioned a considerable part of their content to mathematical logic—usually referred to as *shuxue (de) lunlixue* 數學(的)論理學. The first such secondary school textbook emerged in 1925. The book *Logic* (*Lunlixue* 論理學) was written by Wang Zhenxuan 王振瑄 (1928), a teacher at Peking Women's Higher Normal College (*Beijing nüzi gaodeng shifan xuexiao* 北京女子高等師範學校). It was included in the semi-official series *New Education System Senior Secondary School Textbooks* (*Xin xuezhi gaozhong jiaokeshu* 新學制高中教科書), published by the Commercial Press. At this stage, the textbook had not yet offered an overview of the content mathematical logic, nor did it mention any results of Russell's mathematical logic in the section on deduction. Nevertheless, mathematical logic had already been included in the historical overview of development of both Western and Eastern logics (Chinese and Indian logic). A substantial step forward was made in the standardized secondary school textbooks in the early 1930s. Thus, in 1935, Zhang Xizhi's (張希之, ?) book *Essentials of Logic* (*Lunlixue gangyao* 論理學綱要) from 1932 was abridged and upgraded into a textbook, *Senior Secondary School Logic* (*Gaozhong lunlixue* 高中論理學). In 1935 it was reissued under the title *Gaozhong xin biaozhun lunlixue* 高中新標準論理學 (*New Standard Logic for Senior Secondary Schools*). Although Zhang's earlier book had only briefly mentioned mathematical logic, the new one, published just three years later, already included an entire chapter devoted to the "contributions of new deductive method". Aside from a historical introduction to the concept of mathematical logic, Zhang's textbook also introduced the elementary concepts from Russell's *Introduction to Mathematical Philosophy* and *Principia Mathematica*, in particular a few elementary notions from relational and propositional calculi, propositional functions, the Sheffer stroke and so on (Zhang Xizhi 1935, 198–221). Apart from

28 In the 1933, 1936, and 1937 editions the structure and content of the course remained unaltered.

these concepts and principles, Zhang also extensively introduced Shen Youqian's 沈有乾 interpretation of Ladd-Franklin's theory of syllogism together with his *bagua*-based notation. Zhang's book was published in the *New Standard Senior Secondary School Textbooks* series with the Wenhua xueshe 文化學社 in Peking. Zhang's introduction to mathematical logic for secondary schools was not superseded by any new generation of Chinese textbooks. As a matter of fact, in the following years the trend to introduce mathematical logic slowly declined. In the new generation of textbooks, starting with Zhu Zhangbao's 朱章寶 *New Edition Senior Secondary School Logic* (*Xinbian gaozhong lunlixue* 新編高中論理學) from 1940, even though mathematical logic was still mentioned in the historical overview of logic, the section on "new deductive method" (*yanyi xin fa* 演繹新法) was reduced to a less technical introduction of contemporary symbolic logic.

Normal Colleges and Universities

The implementation of early education system reforms in early 1930s brought similar curricular modifications to the general course on logic in the framework of national normal colleges. The document *Curricular Standards for Normal Colleges* from 1934[29] provides the following outline of the prescribed content of the course on logic (called "*Lunlixue* 論理學"): a) Analysis of Thought (with an emphasis on the ability to identify fallacies and the so-called truth-standards etc.); b) Essentials of the Scientific Method; c) Induction; d) Deduction: i) Deductive Systems; ii) Terms and Classes; iii) Propositions and Propositional Forms; iv) Exposition of Formal Deduction: 1) Aristotelian Logic and 2) New Method of Mathematical Logic (*shuxue luoji* 數學邏輯): (Calculus of Classes, Calculus of Propositions, Calculus of Propositional Functions (*ci zhi hanshu* 辭之函數). The course on logic was also cancelled from the basic curriculum for normal colleges, only a few years after it was removed from the secondary school curricula in 1946. In the early 1930s, introductory courses on logic (usually called "*Lunlixue* 論理學") became a common component of the general curriculum for the first-year undergraduate students. Initially, these were elective courses, usually conducted by members of the departments of philosophy. As in the case of Qinghua University, the course of logic was offered as a part of a bundle of elective courses in science or humanities. Later, the status of logic at universities rose, as it became an independent mandatory course for all first-year students at national universities.

29 See the Editorial Committee for Elementary and Secondary School Curricular Standards of the Ministry of Education (1934).

Consequently, logic also became a topic of entrance exams, as well as general exams at the end of each academic year. The growing presence of logic in university curricula also entailed a growing need for standard elementary and advanced textbooks on the subject. Following the reforms of the late 1920s, there was also an increase in the number of translations of Western textbooks on logic as well as textbooks written by various Chinese authors. Moreover, because mathematical logic became a synonym for contemporary logic, in the 1930s there was also a growing need for Chinese textbooks which would include mathematical or contemporary symbolic logic. Beside the most important textbooks, such as those written by Wang Dianji and Jin Yuelin, the late 1930s and early 1940s saw the publication of further textbooks written by young Chinese philosophers, which included at least a section devoted to modern logic. The first such noteworthy book was Shen Youqian's short overview of *Modern Logic* (*Xiandai luoji* 現代邏輯) from 1933, and the other was Mou Zongsan's *Logical Paradigms* (*Luoji dianfan* 邏輯典範) from 1940.[30] Throughout the 1920s and 1930s, translations of foreign works in modern logic kept emerging at a relatively steady pace. Even though already from the 1920s on a relative abundance of new Chinese publications on modern logic was available to Chinese readers and scholars, the evolution of standard material prescribed for elementary courses in logic at Chinese universities seems not to have followed the same developmental trajectory. Instead, lecturers in logic at more marginal universities kept prescribing already outdated Western textbooks, which did not include symbolic or mathematical logic at all. Often these universities tended to retain the earlier pragmatist approach towards teaching logic. Even at Qinghua, in 1933 the textbook on logic, which was prescribed for the entrance examination and the general exam at the end of the year, was Wolf's *Essentials of Logic* from 1926.[31]

On the other hand, the content of basic university courses on logic depended largely on the lecturers. A general view of Chinese universities in early 1930s reveals that sometimes the modern outlook of the course on logic was correlated to the lecturer's affiliation with the Qinghua School of Philosophy. A solid example of this would be Peking University, where Zhang Shenfu lectured on mathematical logic. Another example was the newly founded Wuhan University, where contemporary logic was taught by Wan Zhuoheng 萬卓恆 a former student of Qinghua College (class of 1923) and the holder of a master's in philosophy from Harvard. In 1930s and 1940s Wuhan University was known as one of the few Chinese universities where mathematical logic was taught both in the framework of the general course on logic and as a specialized course (advanced logic) at

30 On Mou Zongsan's early work related to modern logic, see Suter (2017); Vrhovski (2020).

31 See Qinghua daxue (1933).

the Department of Philosophy.[32] Sometimes, however, the most important factor behind the development of more advanced courses on logic was, quite naturally, the lecturer's familiarity with the subject, mostly through first-hand experience gained at Western universities.

The educational background of lecturers also greatly influenced the selection of specialized elective courses, both at undergraduate and graduate levels, within the curricula at departments of philosophy across the country. Thus, for example, Qinghua's status as the centre for mathematical logic in China was inextricably linked to Jin Yuelin's pedagogical and scientific work as well as Zhang Shenfu's intensive propagation of the notion of mathematical logic. In other words: a broad selection of lectures on logic was the first condition of development of the discipline of modern logic at the department, and more than on anything else this depended on the pedagogical effort of the lecturers and their efforts at the broader dissemination or popularization of this new subject of learning.

According to documentary evidence and biographical material, by the early 1930s Chinese logicians' efforts to popularize the notion of mathematical logic in China were extremely fruitful. Various indications speak in favour of this assumption, the most important of which was, of course, the inclusion of mathematical logic into secondary and normal curricula. At the university level, the education system reforms of the early 1930s materialized mainly in the establishment of a mandatory general course in logic for all freshmen at universities. Apart from that mathematical logic became gradually recognized as an integral part of curricula at national philosophy departments. Although the levels of inclusion varied between historical overviews and concrete theoretical introductions, mathematical logic also became a specialized, selective course at some philosophical departments.

However, this change did not occur overnight, because in the early 1930s mathematical logic was actually taught only at an extremely small number of Chinese universities, considerable efforts were needed to achieve its broader presence in Chinese academia. Thus the draft version of the document *University Courses* (*Daxue kemu* 大學科目) from 1933, which enumerated the basic mandatory courses, still mentioned only the course "Logic" (*Lunlixue*).[33] The original content

32 Wan Zhuoheng is also mentioned in He Lin's book *Modern Chinese Philosophy* (1947) as one of only a handful of Chinese experts in the field of mathematical logic. He's recognizing Fan as a mathematical logician probably rested on his reputation as one of only few professors of logic, who attached great importance to the mathematical logic of Russell's *Principia Mathematica* (see He Lin 1947, 31).

33 The booklet *Draft of the University Courses* (*Daxue kemu caoan* 大學科目草案), issued by the Chinese Ministry of Education in 1933, also prescribed the basic literature for the course, namely the following two books: Josiah Royce's "The Principles of Logic" (1913) and J. E. Creighton's

was extended and upgraded in the revised version of the *List of University Courses* from 1940, which provided a list of both obligatory and selective courses. In this document (or possibly even earlier) "Mathematical Logic" was listed as the standard selective course for undergraduate programs in philosophy, prescribed to be taught in the fourth year of study (Ministry of Education 1940, 48).

Concluding Remarks

The above analysis reveals that the advances in Chinese studies of mathematical logic were represented, above all, by the so-called "Qinghua School of (Mathematical) Logic". In its earliest years, as the central Chinese platform for research on Russell's philosophy and his *Principia Mathematica*, the Department of Philosophy at Qinghua University defined the state of Chinese knowledge of the topic and at the same time assumed the role of the main disseminator of the Russellian notion of mathematical logic. To a certain degree, this early period of mathematical logic at Qinghua was epitomized by Jin Yuelin's work *Logic*, while at the same time it also marked an important transition of the research interest of the members of the school towards developments in the framework of the Harvard School of Logic on one side, and trends in European mathematical logic on the other. Similarly, in the late 1930s the new generation of logicians at Qinghua University also assumed the leading role in raising Chinese research into the discipline to a new level. This final chapter of mathematical logic at Qinghua was defined by the introduction of more recent advances in European mathematical logic into the curriculum at the department.

However, in the framework of the school of logic at Qinghua University mathematical logic was still deeply immersed in the context of philosophical studies, and consequently also generally explicated in a profoundly philosophical manner. Secondly, as a school of thought, the development of the Qinghua School was also strongly inclined towards particular theories and currents in mathematical logic, and therewith also more or less disassociated from specific other such theories. Thus, one example of a theory which was not at the centre of inquiries at Qinghua was Hilbert's formalist project, which also offered its own solution to the foundations of mathematical logic. The task of introducing Hilbertian formalism, Cantorian set theory and other topics from mathematical logic to Chinese scholars was later assumed by a group of Chinese mathematicians headed by Tang Zaozhen, a professor at Wuhan University, and Zhu Gongjin, a mathematician

An Introductory Logic (1919 edition). Both were also available in Chinese, and the translators were Tang Bohuang 唐擘黃 (Tang Yue 唐鉞, 1891–1987) and Liu Qi 劉奇, respectively.

who studied under Hilbert. The related developments which took place at Wuhan University and in the framework of the popularization and introduction of mathematical logic in mathematical journals can be described as a step in the direction of the mathematization of the notion of mathematical logic in China. Moreover, the research conducted by the leading figures in this movement, such as Tang Zaozhen and Xiao Wencan at Wuhan University, was profoundly different from the that conducted at Qinghua School, since the notion of mathematical logic as well as its content were regarded within the context of mathematics, and as a branch of mathematics closely related to the problems of its foundations. Based on its different conceptualization, the notion of mathematical logic produced through this important turn can be described as the current of the "mathematical notion" of mathematical logic.

Finally, the degree of the establishment of the notion of mathematical logic in the more general intellectual discourse in late 1920s and 1930s China is further attested by the inclusion of its content into the new, standardized secondary school and university curricula. In the context of the standardization and modernization of the logical curricula, the integration of content from mathematical logic as a most highly developed form of deductive logic reached its peak in the first half of the 1930s, when several new standard textbooks for secondary schools already included elementary concepts from *Principia Mathematica* and related works by Russell and others. Together with the rise of the notion of mathematical logic as the newest form of deductive logic a new terminology started to form, which possessed a strongly modern undertone. Although this distinction originated in the earliest introduction of the notion in the early 1920s, by the 1930s the difference between traditional and modern logic became expressed more uniformly in the terminology used to describe these two developmental stages in Western logic. On the other hand, the use of terminology in the 1930s also revealed an indirect influence of broader philosophical and political trends on logical terminology. An important influence was that of cultural relativism, which created the urge to differentiate the universal idea of logic from "culturally conditioned" evolutionary versions of logic, such as Indian, Chinese or Greek Aristotelian logic. When this first concerted attempt at standardizing logical terminology was completed in 1939, some of these distinctions were still retained, while in the actual literature the terminological gaps remained considerable. For these as well as other reasons, a focused study of the shifts and changes in Chinese logical terminology in the 1920s and 1930s is needed.

Unfortunately, the development of mathematical logic in the years following the outbreak of the Sino-Japanese war is, due to circumstances of the time, very poorly documented. As a consequence, there is a wide and unsurmountable gap in our understanding of the later parts of the trends and developments described above. In the end, however, with the profound changes that took place at the establishment of the PRC in 1949 the majority of these developments were brought to an abrupt end. In this way, our treatment of these early developments will serve as a basis for assessing the degree of discontinuity and change rather than the main basis for describing a general continuity in Chinese studies of mathematical logic. Moreover, a deeper insight into the developments of mathematical logic at Chinese universities during wartime, which probably brought the foremost experts in the field closer together than ever before and thus provided very favourable circumstances for the development of a more unitary or even interdisciplinary developmental trajectory, would also provide the missing narrative link between the period under examination in this article and the profoundly disparate developments in the late 1940s and early 1950s. Since we are still unable to provide an adequate insight into the development in mathematical logic that took part under the fog of war which enveloped China between 1937 and 1945, the present study represents the last still historically attainable fraction of its developmental path.

Last but not least, perhaps the most indisputable dimension of continuity was retained through the key agents who contributed to the re-formation of mathematical logic in the first decade of the PRC, such as Hu Shihua, who obtained their basic training in the milieu of the Qinghua School (in the late 1920s and early 1930s its members lectured at all other leading Chinese universities), and whose work in mathematical logic was not sanctioned in the framework of the ideological transition that took place in Chinese academia in the early 1950s.

Acknowledgment

The author acknowledges the financial support from the Slovenian Research Agency (ARRS) in the scope of the research project N6-0161 (Complementary scheme) *Humanism in Intercultural Perspective: Europe and China*.

References

Bernays, Paul, and Abraham A. Fraenkel. 1958. *Axiomatic Set Theory*. Amsterdam: North-Holland Publishing Company.

Cheng, Minde 程民德. 1994. *Zhongguo xiandai shuxuejia zhuan* 中國現代數學家傳 (*Biographies of Modern Chinese Mathematicians*), vol. 1. Nanjing: Jiangsu jiaoyu chubanshe.

Ciaudo, Joseph. 2021. "Is 'New Culture' a Proper Translation of Xin Wenhua? Some Critical Remarks on a Long-Overlooked Dilemma." *Asian Studies* 9 (2): 13–47. https://doi.org/10.4312/as.2021.9.2.13-47.

Creighton, James Edwin. 1919. *An Introductory Logic.* New York, London: Macmillan.

Dauben, Joseph W. 2002. "Internationalizing Mathematics East and West: Individuals and Institutions in the Emergence of a Modern Mathematical Community in China." In *Mathematics Unbound: The Evolution of an International Mathematical Research Community, 1800–1945*, edited by Karen Hunger Parshall, and Adrian C. Rice, 253–85. Providence (RI): American Mathematical Society.

Editorial Committee for Elementary and Secondary School Curricular Standards of the Ministry of Education, ed. 1932. *Chuji gaoji zhongxue kecheng biaozhun* 初級高級中學課程標準 (*Curricular Standards for Junior and Senior Middle Schools*). Shanghai: Shangwu yinshuguan.

Editorial Committee for Normal School Curricular Standards of the Ministry of Education, ed. 1934. *Shifan xuexiao kecheng biaozhun* 師範學校課程標準 (*Curricular Standards for Normal Colleges*). Shanghai: Shangwu yinshuguan.

Fan, Shoukang 范壽康. 1931. *Lunlixue* 論理學 (*Logic*). Shanghai: Kaiming shudian.

Fitch, Frederic B. 1943. "Review of *La Philosophie Mathématique et la Théorie des Ensembles* by Tseng Ting-Ho." *Journal of Symbolic Logic* 8 (2): 56–57.

Gao, Xingjian 高行健. 1936. "Shuli luoji ABC (shang) 數理邏輯ABC (上) (ABC of Mathematical Logic (Part 1))." *Kexue shijie* 5 (5): 434–40.

Gödel, Kurt, and Solomon Feferman, ed. 2014. *Kurt Gödel: Collected Works,* volume IV: *Correspondence A-G.* Oxford: Oxford University Press.

Guoli Beijing daxue 國立北京大學. 1929. *Beijing daxue sayi zhounian jiniankan* 北京大學卅一週年紀念刊 (*Commemorative Publication on the 31st Anniversary of Peking University*). Beijing: National Peking University.

Guoli daxue lianhehui 國立大學聯合會. 1929. "Daxue guicheng 大學規程 (Regulations for Universities)." *Guoli daxue lianhehui yuekan* 2 (7): 3–7.

Guoli Wuhan daxue 國立武漢大學. 1932. *Guoli Wuhan daxue yilan* 國立武漢大學一覽 (*National Wuhan University Guide*). Wuchang: Guoli Wuhan daxue.

———. 1934. *Guoli Wuhan daxue yilan* 國立武漢大學一覽 (*National Wuhan University Guide*). Wuchang: Guoli Wuhan daxue.

———. 1936. *Guoli Wuhan daxue yilan* 國立武漢大學一覽 (*National Wuhan University Guide*). Wuchang: Guoli Wuhan daxue.

Hardy, G. H. 1932. "Wuqiongda zhi jie 無窮大之階 (Orders of Infinity)." Translated by Xiao Wencan 蕭文燦. *Guoli Wuhan daxue like jikan* 3 (1): 13–57.

———. 1933. "Wuqiongda zhi jie 無窮大之階 (Orders of Infinity)." Translated by Xiao Wencan 蕭文燦. *Guoli Wuhan daxue like jikan* 3 (3): 1–65.
He, Lin 賀麟. 1947. *Dangdai Zhongguo zhexue* 當代中國哲學 (*Modern Chinese Philosophy*). Nanjing: Shengli chubanshe.
He, Qingqin 何清欽. 1989. "Minguo ershiyi nian woguo zhongdeng xuexiao zhidu gaige jingguo zhi tantao 民國二十一年我國中等學校制度改革經過之探討 (A Study of the Process of Reformation of the Secondary School Education System in China, 1932)." *Jiaoyu xuekan* 8: 75–106.
Hilbert, David, and Wilhelm Ackermann. 1972 [1928]. *Grundzüge der theoretischen Logik* (*Fundamentals of Theoretical Logic*). Berlin, Heidelberg, New York: Springer-Verlag.
Jevons, William Stanley. 1886 [1870]. *Elementary Lessons in Logc: Deductive and Inductive, with Copious Questions and Examples, and a Vocabulary of Logical Terms.* London: Macmillan.
Jin, Yuelin 金岳霖. 1935. *Luoji* 邏輯 (*Logic*). Beijing: Qinghua daxue chubanshe.
Li, Mianyuan 李勉媛. 2016. "Guanyu difang zonghe daxue jiaoshi jiaoxue fazhan wenti de sikao 關於地方綜合大學教師教學發展問題的思考 (A Reflection on the Developmental Questions of Teaching at Provincial Comprehensive Universities)." *Jilin shao jiaoyu xueyuan xuebao* 32 (3): 31–33.
Li, Shurong 李樹榮, and Xiao Xing 蕭星. 2005. "Guizhou zhuming shuxuejia jiaoyujia Xiao Wencan 貴州著名數學家教育家蕭文燦 (Xiao Wencan—The Renowned Mathematician and Educator from Guizhou)." *Guizhou wenshi congkan* 2: 90–92.
Li, Weiwu 李維武. 2009. "Xiandai daxue zhexuexi de chuxian yu 20 shiji shang banye Zhongguo zhexue de kaizhan 現代大學哲學系的出現與20世紀上半葉中國哲學的開展 (Birth of Philosophical School in Modern University and Development of Chinese Philosophy in First Half of the 20th Century)." *Xueshu yuebao* 41 (11): 38–48.
Lin, Xiaoqing Diana. 2012. "Developing the Academic Discipline of Chinese Philosophy: The Departments of Philosophy at Peking, Tsinghua, and Yenching Universities (1910s–1930s)." In *Learning to Emulate the Wise: The Genesis of Chinese Philosophy as an Academic Discipline in Twentieth-Century China*, edited by John Makeham, 131–62. Hong Kong: Chinese University Press.
Ministry of Education (Jiaoyubu 教育部). 1929. "Daxue zuzhifa 大學組織法 (Organizational Law for Universities)." *Fujian jiaoyu zhoukan* 41: 12–13.
———. 1933. *Daxue kemu caoan* 大學科目草案 (*Draft of the University Courses*). Shanghai: Commercial Press.
———. 1940. *Daxue kemu biao* 大學科目表 (*List of University Courses*). Chongqing: Zhengzhong chubanshe.

———. 1942. *Xiuzheng chu, gaoji zhongxue kecheng biaozhun* 修正初、高級中學課程標準 (*Revised Curricular Standards for Junior and Senior Middle Schools*). Chongqing: Zhengzhong shuju.

Mou, Zongsan 牟宗三. 1940. *Luoji dianfan* 逻辑典范 (*Logical Paradigms*). Chongqing: Shangwu yinshuguan.

Pepper, Suzanne. 1996. *Radicalism and Education Reform in Twentieth-Century China: The Search for an Ideal Development Model.* Cambridge, New York: Cambridge University Press.

Qinghua daxue 清華大學. 1933. "Yubei toukao Qinghua de cankaoshu mulu 預備投考清華的參考 書目錄 (A Reading List for Preparations for Enrolment into Qinghua University)." *Qinghua shuqi zhoukan* 3/4: 87–88.

Ren, Nanheng 任南衡, and Zhang Youyu 張友余. 1994. *Zhongguo shuxuehui shiliao* 中國數學會史料 (*Historical Materials of Chinese Mathematical Society*). Nanjing: Jiangsu jiaoyu chubanshe.

Royce, Josiah. 1913. "The Principles of Logic." In Louis Couturat, Benedeto Croce, Federigo Enriques, Josiah Royce, Arnold Ruge, and Wilhelm Windelband. *Encyclopaedia of the Philosophical Sciences: Logic*, volume 1, 67–135. Translated by B. Ethel Meyer. London: Macmillan.

Russell, Bertrand. 1919. *Introduction to Mathematical Philosophy*. London: George Allen & Unwin Ltd.

Russell, Bertrand [Luosu 羅素]. 1922. *Luosu shuli zhexue* 羅素數理哲學 (*Russell's Mathematical Philosophy*). Translated by Fu Zhongsun 傅種孫, and Zhang Bangming 張邦銘. Shanghai: Shangwu yinshuguan.

Shen, Youqian 沈有乾. *Xiandai luoji* 現代邏輯 (*Modern Logic*). Shanghai: Xinyue shudian.

Shi, Mingde 時明德, and Zeng Zhaoshi 曾昭式. 1998. "Shuli luoji zai Zhongguo fazhan zhihuan de yuanyin tanxi 數理邏輯在中國發展滯緩的原因探析 (An Exploration of Reasons of Slow Development of Mathematical Logic in China)." *Xinyang shifan xueyuan xuebao* 18 (2): 29–33.

Suter, Rafael. 2017. *Logik und Apriori zwischen Wahrnehmung und Erkenntnis: Eine Studie zum Frühwerk Mou Zongsans (1909–1995)*. Berlin: Walter de Gruyter.

———. 2020. "Logic in China and Chinese Logic: The Arrival and (Re-) Discovery of Logic in China." In *Dao Companion of Chinese Philosophy of Logic,* edited by Fung Yiu-ming, 465–509. Cham: Springer Nature Switzerland AG.

Tang, Zaozhen 湯璪真. 1930, trans. "Jihe lilun jihexue 集合理論幾何學 (Set-Theoretical Geometry)." *Guoli Wuhan daxue like jikan* 1(2): 40–48.

Tseng, Ting-ho. 1938. "La philosophie mathématique et la théorie des ensembles (Mathematical Philosophy and Set Theory)." PhD diss., University of Paris.

Tu, Xiaoshi 屠孝實. 1926. *Mingxue gangyao* 名學綱要 (*Logic Primer*). Shanghai: Shangwu yinshuguan.

Turner, J. S. 1928. *Mathematical Logic*. Ames (Iowa): Iowa State College.

Vrhovski, Jan. 2020. "From Mohism to the School of Names, from Pragmatism to Materialist Dialectics: Chinese Interpretations of *Gongsun Longzi* as a Text and Source of Chinese Logic, 1919–1937." *International Communication of Chinese Culture* 7 (4): 511–38.

———. 2021a. "'Qinghua School of Logic': Mathematical Logic at Qinghua University in Peking, 1926–1945." *History and Philosophy of Logic* 42 (2): 247–61.

———. 2021b. "Balance and Innovation: Approaches to Logic and the Teaching of Logic in the Philosophy Department of Peking University, 1916–1927." *History and Philosophy of Logic* 15 (1): 1–23.

Wang, Zhenxuan 王振瑄. 1928. *Lunlixue* 論理學 (*Logic*). Shanghai: Shangwu yinshuguan.

Wolf, Abraham. 1926. *Essentials of Logic*. London: George Allen & Unwin Ltd.

Xiangren 湘人 [Hunanese]. 2017. *Xiao Shafu pingzhuan* 蕭箑父評傳 (*A Critical Biography of Xiao Shafu*). Kaohsiung: Duli zuojia – Xinrui wenchuang.

Xiao, Weili 肖偉例. 2010. "Zhou Gucheng yu Mao Zedong 周穀城與毛澤東 (Zhou Gucheng and Mao Zedong)." *Xinxiang pinglun* 10: 36–37.

Xiao, Wencan 蕭文燦. 1933. "Jihelun 集合論 (Set Theory)." *Guoli Wuhan daxue like jikan* 4 (2): 30–63.

———. 1939. *Jihelun chubu* 集合論初步 (*Elementary Set Theory*). Shanghai: Shangwu yinshuguan.

Xu, Yibao. 2003. "Bertrand Russell and Mathematical Logic in China." *History and Philosophy of Logic* 24: 181–96.

———. "Concepts of Infinity in Chinese Mathematics." PhD diss., The City University of New York.

Zhai, Jincheng 翟錦程. 2016. "Zhongguo jindai luojixue jiaoyu de jige wenti 中國近代邏輯學教育的幾個問題 (Several Issues of Education of Logic in Modern China)." *Huabei shuili shuidian daxue xuebao (Shehui kexue ban)* 32 (1): 59–63.

Zhang, Shizhao 章士釗. 1943. *Luoji zhiyao* 邏輯指要 (*Essentials of Logic*). Chongqing: Shidai jingshenshe.

Zhang, Xizhi 張希之. 1932. *Lunlixue gangyao* 論理學綱要 (*Essentials of Logic*). Beiping: Wenhua xueshe.

———. 1935. *Gaozhong lunlixue* 高中論理學 (*Senior Secondary School Logic*). Beiping: Wenhua xueshe.

Zhang, Youyu 張友余. 1991. "Sanshi niandai de *Shuxue tongbao* 三十年代的《數學通報》(The *Bulletin of Mathematics* in the 1930s)." *Shuxue tongbao* 8: 2–3.

Zhu, Yanjun 朱言鈞. 1928a. "Bo shiyan zhuyi 駁實驗主義 (A Refutation of Experimentalism)." *Minduo zazhi* 9 (4): 1–8.

———. 1928b. "Zai bo zhiyan zhuyi 再駁實驗主義 (A Further Refutation of Experimentalism)." *Minduo zazhi* 9 (4): 1–5.
———. 1928c. *Lixing piping pai de zhexuejia Naersong (ta de shengping yu xueshuo)* 理性批評派的哲學家納爾松 (他的生平與學説) (*Nelson—A Philosopher of Critical Rationalism (His Life and Teaching)*). Shanghai: Shangwu yinshuguan.
———. 1929a. "Xin jihexue yu zhexue 新幾何學與哲學 (New Geometry and Philosophy)." *Guanghua qikan* 5: 1–4.
———. 1929b. "Zuijin suanxue jie zhong de liang da chaoliu 最近算學界中的兩大潮流 (Two Major Currents in Mathematical Circles of the Recent Years)." *Guanghua qikan* 5: 1–7.
———. 1929c. "Cong renshilun dao pipinglun 從認識論到批評論 (From Theory of Knowledge to Critical Theory). *Zhexue pinglun* 2 (4): 1–12.
———. 1929d. "Xuanxue yu ziran kexue de guanxi 玄學與自然科學的關係 (On the Relationship between Metaphysics and Natural Science). *Zhinan* 100: 28–37.
———. 1929e. "Sugeladi yu Na'ersong 蘇格臘底與納爾松 (Socrates and Leonard Nelson)." *Zhexue pinglun* 2 (4): 13–18.
———. 1932. "Hebaide Hilbert Jiaoshou zhi shenshi jiqi yuanli shuo 赫百德 Hilbert 教授之身世及其原理說 (Professor Hilbert's Life Experience and his Theory of Axiomatics)." *Guanghua daxue banyuekan* 1: 2–8.
———. 1933. "Shuli luoji gangyao 數理邏輯綱要 (Essentials of Mathematical Logic)." *Zhexue pinglun* 4 (3–4): 51–76.
———. 1934a. "Cong gaodeng shuxue de guandian tantan chudeng shuxue 從高等數學的觀點談談初等數學 (Speaking About Elementary Mathematics from the Point of View of Advanced Mathematics)." *Guanghua daxue banyuekan*, 3 (2): 8–14; 3 (3): 21–26; 3 (4): 26–31.
———. 1934b. "Shuli luoji gangyao 數理邏輯綱要 (Essentials of Mathematical Logic)." *Guoli Wuhan daxue like jikan* 5 (2): 179–205.
———. 1935a. "Jinnian lai suanxue zhong zhi liang da sichao 近年來算學中之兩大思潮 (Two Major Tides of Thought in Mathematics in the Past Few Years)." *Guanghua daxue banyuekan* 3 (9/10): 244–56.
———. 1935b. "Shuxue zhong zhi tuili fangfa 數學中之推理方法 (Methods of Inference in Mathematics)." *Guanghua daxue banyuekan* 4 (1): 31–36.
———. 1935c. "Dingxing jihexue yu wuren zhi kongjian guan 定性幾何學與吾人之空間觀 (Topological Geometry and Our Views on Space)." *Xueshu shijie* 1 (2): 31–33.
———. 1936a. "Shuxue renshi zhi benyuan 數學認識之本源 (The Origins of Mathematical Knowledge)." *Shuxue zazhi* 1 (1): 6–19.
———. 1936b. "Shuli luoji daolun 數理邏輯導論 (An Introduction to Mathematical Logic)." *Shuxue zazhi* 1 (1): 80–94.

———. 1936c. "Jilun xiaotan 集論小談 (Casual Conversations on Set Theory)." *Guanghua dauxe banyuekan* 4 (9): 28–35.

———. 1937a. "Shuxue yuanlixue zhi piping 數學原理學之批評 (Critiques of Mathematical Axiomatics)." *Tushu zhanwang* 2 (9–10): 49–53.

———. 1937b. "Jilun xiaotan 集論小談 (Casual Conversations on Set Theory)." *Guanghua dauxe banyuekan* 5 (9): 24–26.

———. 1947. *Shuli congtan* 數理叢談 (*Mathematical Discussions*). Shanghai: Shangwu yinshuguan.

Zhu, Zhangbao 朱章寶. 1940. *Xinbian gaozhong lunlixue* 新編高中論理學 (*New Edition Senior Secondary School Logic*). Chongqing: Zhonghua shuju.