

External Examiner's Report on the Dissertation of Jan Vrhovski
**"Patterns of Thought and Numbers: A History of Mathematical Logic in Late
Republican and Early Socialist China (1930-1960)"**
Submitted in 2021 at the Faculty of Arts of Charles University

I. Brief summary of the dissertation

The dissertation offers a detailed institutional, intellectual, and ideological account of the transformation of the field of mathematical logic from primarily a branch of philosophy in Late Republican China to primarily a branch of mathematics in Early Socialist China. The author examines the role of international connections, political and ideological debates, biographical trajectories, and institutional contexts to explain the distinctive foci of research in and characterization of mathematical logic as both a domain of study and an academic discipline in China in the three decades from 1930 to 1960. The dynamic interaction of these multiple dimensions contributes, in particular, to an explanation of developments in the 1950s that resulted in a comparatively narrow but politically autonomous scientific field oriented toward computing applications, a striking shift away from the ideological and intellectual emphases in Chinese mathematical logic from which this outcome emerged.

II. Brief overall evaluation of the dissertation

This dissertation represents an original and significant contribution to scholarship worthy of a doctorate. It makes a sophisticated and convincing intervention in the literature on modern mathematics in China, demonstrating a sound comprehension of relevant interlocutors, debates, and frameworks. It assembles and knowledgeably interprets an impressive collection of evidence in several languages with nuance and clarity. It exhibits an effective combination of methodologies and analyses, including institutional history, political history, intellectual history, scientific biography, and conceptual exegesis through close reading of ideological and scientific works. Indeed, its greatest strength is the mutually illuminating interpolation of multiple methodologies to explain historical developments that can appear arbitrary from just one perspective. The exposition is coherent, with an allowable quota of grammatical or linguistic inaccuracies or infelicities. Congratulations to the author on an excellent dissertation.

III. Detailed evaluation of the dissertation and its individual aspects

In this dissertation, Jan Vrhovski presents an ambitious new account of the transformation of mathematical logic as a concept and field of academic study in China from the late 1920s to the early 1960s. Vrhovski convincingly asserts that it is necessary to view these two sides of mathematical logic as a linked pair, both sides of which were subject in different ways to the dramatically shifting circumstances of the period under investigation. Particularly amidst the high-stakes ideological contestations of the early People's Republic of China, set against a longer backdrop of Soviet and Sino-Soviet interpretation of politically important Marxist and Marxist-Leninist texts, one cannot explain the institutional and intellectual dynamics of

research in mathematical logic without detailed attention to the delicate negotiations that framed what the field meant (sometimes but not always superficially) in political-ideological terms, and vice versa. These explanations, developed primarily across the outsized part 3 of the dissertation, offer a significant new understanding of the history of logic in China that offers implications of considerable potential interest to historians of science, mathematics, and the twentieth-century more broadly.

A brief introduction stakes the dissertation's main claims, articulating the distinction between the two views of mathematical logic and previewing the major claims with reference to the limited specific literature on logic in modern China (to which, it should be said, Vrhovski has already made a meaningful contribution apart from this thesis). The author offers two methodological framings, one derived from Daston and Galison's *Objectivity* and one from Chun-chieh Huang's transfer of ideas model. Neither is particularly clear or convincing, nor satisfyingly followed up in the dissertation, and I am left with doubts as to how well these reference points have been understood. At least, there are significant dimensions of the author's interpretation left unsaid that probably ought to have been said. There is, generally speaking, a paucity of direct discussion of methodological or thematic reference points from the wider historiography throughout the dissertation. None of this is too problematic, as the author's own methodological and thematic framing stands well enough on its own terms. However, care must be taken when continuing the research and revising this material for publication to reconsider and strengthen the engagement with other relevant literature appropriate to the respective settings.

The next part of the dissertation examines mathematical logic beginning with its first institutionalized appearances in Late Republican China, emphasizing the subject's heterogeneity across different settings of Chinese academia. This diversity owed in part to the local legacies of individual Chinese scholars' international studies, travels, and connections, and the analysis accordingly dwindles for the period from the late 1930s when war troubled those international ties and added major domestic disruptions as well. The discussion begins with what Vrhovski terms the Qinghua School of Logic, a community (or at least a colocation) of logicians practicing mathematical logic as a branch of philosophy in the tradition of Bertrand Russell and his and Whitehead's *Principia Mathematica*. (The literature on mathematical and scientific research 'schools' is an example of a robustly thematized area of historiography that could be fruitfully engaged in future work.) The discussion acknowledges and to a limited extent explains the interactions with a prior tradition of philosophical logic linked to American pragmatism (the Boxer Indemnity is not mentioned) that remained widespread in Chinese academia in this period. Regarding the Qinghua logicians, the author explains their interest in Russellian mathematical logic and its manifestation in institutional, curricular, professional, and technical developments, showing the presence and interaction of a multiplicity of approaches tied to the logicians' different international connections.

While a presiding theme of the dissertation is the institutional shift of mathematical logic from philosophy to mathematics, Vrhovski shows that this shift was preceded and in some sense facilitated by a parallel development of the field among mathematicians at the upstart National Wuhan University. Defined by particularly strong ties to German scholarship and a more Hilbertian tradition, these logicians established a domestic field of mathematical logic

as a subject for mathematicians. The author traces their scholarship and influence as well as the Qinghua counterpart with nuance and insight through an analysis of relevant developments in mathematics exposition, curriculum reform, and terminological reform.

Largely passing over the 1940s, a period about which there is not much evidence and that was experienced by historical figures themselves as something of a caesura (from an academic perspective at least), the bulk of the dissertation then discusses the dramatic transformations of mathematical logic amidst the even more dramatic transformations of the 1950s revolution and early People's Republic. An extended discussion of the limited but influential remarks of Engels, Lenin, and their later Soviet interpreters on logic and the philosophy of mathematics lays the ground for a nuanced presentation of the ideological stakes for mathematics and logic in Maoist China. Academic life in the PRC's first decade was defined by a precarious negotiation of ideological and institutional positioning that drew on new relationships with the Soviet Union and responded to a series of major political and social developments from the country's political leadership. Mathematical logicians adopted multiple strategies to justify or adapt their work, and Vrhovski offers a detailed and nuanced analysis of how their activities and conditions fit against the decade's changes in both China and the Soviet Union. The mathematical institutionalization of mathematical logic followed the new institutional framework derived from a Soviet model, but also reflected logicians' resourceful navigation of specific Chinese ideological and institutional conditions to articulate a space for mathematical logic as a form of applied mathematics and eventually a part of new formations of computer science.

The institutional-intellectual argument identifies the Chinese Academy of Sciences as the key post-revolution institutional nexus, initially offering a refuge and setting for reframing mathematical logic before nucleating the subject's later return to Chinese universities. To survive, Chinese scholars sought ideologically defensible rationales and orientations for their projects. They ultimately found cover and new opportunities in electronic computing as beneficiaries of Sino-Soviet technical cooperation. In international terms, Vrhovski presents this as a pyrrhic victory for Chinese logicians, sacrificing breadth and relevance for local perseverance through "extreme specialisation" compatible with their conditions of survival. The analysis concludes with a biographical discussion of Hu Shihua, whose career through 1960 tracked the dissertation's major themes and who was a major contributor to the socialist reinvention of mathematical logic in the 1950s.

A brief conclusion recapitulates the major findings, appropriately emphasizing the connections between ideological, institutional, and intellectual histories.

As a whole, the dissertation's structure is somewhat imbalanced but in a way that understandably reflects the imbalance of the subject matter. It is, fundamentally, a big story about the transformation of mathematical logic in China in the 1950s which depends on a subsidiary story of the field's development in the 1930s and a further tranche of background to the ideological status of mathematics within Leninist, Stalinist, and Maoist philosophy. The structure is clear and well signposted with well articulated objectives.

Formally, I found the dissertation mostly clear and accurate, with some moments each of

artfulness and of awkwardness. Some discursive footnotes contained important analysis that would have been better to include in the main text; a small number of other footnotes were digressive and unnecessary. Syntax and formatting are challenging for a work with this breadth of sources and languages, and appears almost entirely sound apart from a minor tendency to drop capitalization and to misplace end-of-sentence citations. Grammatically, I noticed a number of misplaced commas and dropped articles that do not detract significantly but can hopefully be rectified in revision. Language and usage included a few malapropisms or less-standard usages, e.g. “developmental” in many contexts where alternative wordings would be more common. These are all ultimately minor comments on a text that shows a solid command of the language.

The author uses an impressive collection of sources transparently, appropriately, and convincingly. These are mostly published materials, including a range of genres from memoir to technical report to political treatise. Many are hard to find and involve subtle linguistic challenges that the author navigates well. As discussed above, the analysis amounts to a significant original contribution to the field.

IV. Questions for the author

Such a rich and ambitious dissertation will necessarily provoke numerous questions. These should largely be considered directions for future pursuit rather than deficits to the existing presentation, however I hope that discussing these with the author will further illuminate the work that has already been done and the insight the author has developed from this.

1. Methodologically, you have inevitably worked with a large number of sources recounting or engaging with past events in ways that will necessarily be strongly coloured by subsequent intellectual and ideological developments. There are a few isolated places where you identify dubious attributions or possible mistaken or distorted recollections, but other times you appear to take these sources mostly at face value. When nuanced questions of ideological framing are central to your analysis (as they are here), how do you appropriately and critically interpret retrospective evidence and what justifies face-value uses where adopted?
2. A more standard reading of the recent historiography on “objectivity” emphasizes the construction of scientific selves and the sociotechnical adoption of particular epistemic virtues, reflected in particular scientific practices. The evidence in this dissertation could certainly support such an analysis, particularly with regard to the interplay of biographical, ideological, and institutional dimensions. How would you explain the key points of this historiography and how might your analysis look in terms of these aspects? How might the story of mathematical logic in China revise some of the assumptions or conclusions of this historiography (Daston and Galison’s formulation or otherwise)? I wonder especially about the question of the personal social background and formation of logicians; Hu’s story suggests this could be a major dimension for historiographical insight.
3. A key aspect of the 1930s analysis is the role of scholarships and international travel.

In the 1950s, Cold War technical exchanges and political-institutional alignment have a major place. Who is funding the scholarships/travel and why? What are the rationales and resources behind the later exchanges? In sum, what is the political economy behind the ideological, intellectual, and institutional analysis you have offered?

4. Your 1930s philosophical mathematical logicians often had strong interests in the philosophy of language and linguistics. Your 1950s figures included machine translation and computational linguistics among their acceptable research topics. Yet they do not appear (in this account) to be particularly interested in the distinctiveness of Chinese as a non-alphabetic language. Mullaney has, for instance, argued that the philosophical and technical challenges of that distinction were defining problems for Chinese technologists, philosophers, and others for a long period of time including your dissertation's periodization. Did symbolism and the alphabetic conventions of propositional calculus figure in the discussions you analysed? Did alphabetic vs non-alphabetic or other linguistic differences have a role? If so, what was the effect? If not, can you account for the absence?
5. You suggest that by the end of the 1950s Chinese logicians had developed a unique mathematical logic. Did they see it as unique? Did foreign interlocutors see it that way? To what extent is what you identify as Chinese Socialist mathematical logic comparable to the iconic Polish counterpart (deliberately developed as a distinct approach and widely recognized as such), how do you articulate its distinctiveness, and how does your articulation as a historian compare to the articulations of your historical subjects?
6. The wartime interval between the 1930s and 1950s is largely missing from your account, understandably for many reasons. What do historians know about this period that could add to our understanding of your topic? What speculations or inferences about this connective interval can you draw that you might not have been able to evidence satisfactorily in the dissertation itself?
7. Computing, computers, and informatics often feel like a background factor in your analysis. How might your argument look if these were placed at the centre? How might your analysis engage with the broader historiography of computing and algorithms in Chinese, Cold War, and other contexts?
8. Your argument about the relationship between ideologies, concepts, and institutions is convincing. However, one often sees a suggestion that the kinds of ideological moves you discussed are only ever superficial: an academic will say whatever they need to say to be able to do the research that they want to do. Soviet geneticists didn't stop under Lysenkoism, they just joined departments of nuclear medicine. From your findings, how fundamentally transformative were the ideological engagements, and

what methodological and conceptual consequences can you identify?

V. Conclusion

I provisionally classify the submitted dissertation as *passed*.

9 December
2021

A handwritten signature in black ink that reads "Michael J. Barany". The signature is written in a cursive style with a large, sweeping initial 'M'.

9 December 2021

Dr Michael J. Barany, University of Edinburgh