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Sofia A. Yanovskaya: The Marxist Pioneer of Mathematical Logic in the Soviet Union

Dimitris Kilakos[1]

Abstract

K. Marx's 200th jubilee coincides with the celebration of the 85 years from the first publication of his "Mathematical Manuscripts" in 1933. Its editor, Sofia Alexandrovna Yanovskaya (1896–1966), was a renowned Soviet mathematician, whose significant studies on the foundations of mathematics and mathematical logic, as well as on the history and philosophy of mathematics are unduly neglected nowadays. Yanovskaya, as a militant Marxist, was actively engaged in the ideological confrontation with idealism and its influence on modern mathematics and their interpretation. Concomitantly, she was one of the pioneers of mathematical logic in the Soviet Union, in an era of fierce disputes on its compatibility with Marxist philosophy. Yanovskaya managed to embrace in an originally Marxist spirit the contemporary level of logico-philosophical research of her time. Due to her highly esteemed status within Soviet academia, she became one of the most significant pillars for the culmination of modern mathematics in the Soviet Union. In this paper, I attempt to trace the influence of the complex socio-cultural context of the first decades of the Soviet Union on Yanovskaya's work. Among the several issues I discuss, her encounter with L. Wittgenstein is striking.

Keywords: Sofia A. Yanovskaya; History of Logic; Women in Sciences

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Introduction

Sofia Alexandrovna Yanovskaya is a prominent figure for the history of mathematics in the Soviet Union. Unfortunately, though, her contribution remains relatively unknown, especially beyond the former Soviet Union. Yanovskaya is chiefly known as the editor of the first publication of K. Marx's "Mathematical Manuscripts" in 1933. Undoubtedly, this was a significant milestone in her successful career within Soviet academia. However, I maintain

[1] Dimitris Kilakos [Orcid: 0000-0002-6174-6741] is a Post-Doctoral Fellow in the Faculty of Philosophy at the Sofia University "St. Kl. Ohridski". Address: 15 Tzar Osvoboditel Blvd., Bulgaria – Sofia 1504.
E-mail: dimkilakos@hotmail.com

that Yanovskaya's life and work deserve more scholar interest for several more reasons. In this paper, I trace the influence of the complex socio-cultural context of the first decades of the Soviet Union on her fascinating life and career.

S. A. Yanovskaya was born in 1896 into a Jewish family, in Pruzhany, a small village then in Russian Poland (now in Belarus)[2]. Her birth name was Neimark and her father, Aleksander, was an accountant. When she was almost two years old, her family moved to Odessa; there, in 1905, the 9-year old Sofia witnessed the worker's uprising.

After graduating from the gymnasium in 1914 with a gold medal, Sofia Neimark entered the Higher School for Women in Odessa, which was part of the Novorossiisk University. There she studied mathematics, being tutored by Ivan Jure'vich Timchenko (a noted historian of mathematics) and Samuil Osipovich Shatunovsky (a well-known then mathematician in Russia). During her studies in Odessa, she developed her mathematical skills in a variety of topics, as well as her interest in the history of mathematics.

In those turbulent revolutionary years, Sofia was politically active. While studying in the Gymnasium, she assisted political prisoners as a member of an underground organization. She actively took part in the social uprising burst out throughout Russia with the Great October Revolution, giving up her studies in the university. In November 1918, she joined the Bolshevik wing of the Russian Communist Party. During the civil war, which broke up since counterrevolutionary forces from inside and outside Russia resisted to the victorious Revolution, she defended the Revolution. In 1919, she served the Red Army as a political commissar.[3]

Amidst the turmoil, S. A. Yanovskaya married her comrade Isaac Ilyich Yanovsky in 1918. As her friend M.G. Shestopal describes, Isaac was "her mentor and friend, a man of bright individuality, a pure soul and a deep, clear mind. Along with him, Sofia conducted political activities in the ranks of the Bolshevik Party, shared with him the military life in the civil war, repeatedly being exposed to mortal danger" (Shestopal 1982, 116).[4]

When the Red Army defeated the counterrevolutionary forces, communists had to deal with the even more laborious task of building the new society. Among other duties, of primary importance was the enlightenment of the masses. In that fashion, Sofia became an editor for the "Kommunist" newspaper in Odessa. From 1920 to 1923 she worked for the Odessa Regional Committee of the Bolsheviks.

Throughout these years, mathematics was not a priority for Yanovskaya. However, being an earnest and driven communist, soon after she responded to the call for a new intelligentsia to serve new society's needs. Thus, in 1923 Yanovskaya moved to Moscow and returned to her studies, attending seminars at Moscow State University. In 1924, she

2 For a concise, well-informed and accessible to English-speaking readers biography, one may look at the relevant article on MacTutor History of Mathematics archive, written by J. J. O' Connor and E.F. Robertson
(URL: http://www-groups.dcs.st-and.ac.uk/~history/Biographies/Janovskaja.html - Accessed on October 11, 2018). Several interesting biographical details are also offered in Bashmakova et al. (1966), Gorskii (1970), Bochenski (1973), Anellis (1987a), Anellis (1987b), Bashmakova et al. (1996), Kushner (1996), Trakhtenbrot (1997) and Bazhanov (2001). Levin (2012) is a comprehensive overview of Yanovskaya's life and work. A short and rather modest autobiography is (Yanovskaya 1982).

3 Kilberg describes the following episode from that time: "During the retreat from Odessa, the Whites captured several Red Army soldiers. They shot the prisoners on the bridge, and they fell into the river. Among them [...] was Sofia Alexandrovna. A bullet shot through the high hat's hat. Sofia Alexandrovna fell into the river, managed to swim out and then spent the whole night sitting in the water in the reeds" (Kilberg 1982, 105).

4 Sofia and Isaac had a son, who unfortunately was mentally ill and committed suicide shortly after his mother's death. (Kushner 1991, 71; Bashmakova et al. 1996, 360).

entered the Institute of Red Professors, where she became a student of V.F. Kagan (a significant geometer and historian of mathematics and a specialist on Lobachevsky)[5].

One may not exaggerate in suggesting that those heroic times deeply affected her character. As one of her closest friends writes,

> S. A. Yanovskaya lived a life imbued with kindness to people. Her whole existence was determined by a sense of duty, selflessness, and unselfish service to the cause. A modest and open-minded person, Sofia Aleksandrovna was exceptionally benevolent towards others. A very lively, cheerful and sociable person, she constantly felt the need to communicate with people [...] The name of Sofia Alexandrovna is surrounded by an atmosphere of moral purity. For everyone she met, she evoked a feeling of sympathy. [...] Being an extremely kind person, unusually delicate, she was always ready to respond to someone else's misfortune, to help a good cause. It was done quietly, with inherent tact. (Kilberg 1982, 104-107)

The Quest for "Red Scientists"

Before the Great October Revolution, admission to higher education was not an option for the vast majority of young people (especially workers and peasants). Besides the declared vision to raise class-barriers, the situation mentioned above has been troublesome for Soviet authorities: the number of scientifically educated personnel in pre-revolutionary Russia was insufficient for the implementation of the vast program for the reorganization and modernization of the economy and society in general. The pre-revolutionary intelligentsia neither sufficed for nor was in its totality eager to pursue this goal.

As long as mathematicians are concerned, it seems that efforts to draw them to Marxism had considerably less success than among other scientists (Joravsky 2009, 158). Arguably, this could be - at least partially - explained if the long-lasting influence of religious mysticism among leading Russian mathematicians (especially in Moscow) is taken into account; however, a thorough discussion on this issue is far beyond the scope of this paper.

In this context, Soviet authorities introduced several multifaceted policies to alter this situation rapidly. They aimed to reinforce the proportion of workers among students and, upon their graduation, in academia. These efforts proved to be remarkably efficient. It is noteworthy, for example, that between 1928 and 1932, the number of students trebled and the teaching staff doubled (Joravsky 2009, 238). As the Soviet mathematician O. Iu. Shmidt mentions, "a young man who studies our science, has every chance of becoming a professor at twenty-five" (Joravsky 2009, 238).

Among several initiatives aiming to address the challenge mentioned above, one deserves particular attention for our current purposes, due to S. A. Yanovskaya's participation in it.

The Institute of Red Professors of the All-Union Communist Party (Bolsheviks) was founded in February 1921 in Moscow. It was a specialized higher educational institute, meant to address the shortage of Marxist professors. Its programs were training teachers for higher educational institutions, as well as specialists for scientific research institutions and the Communist Party's and Soviet state's organs. Between 1921 and 1928, 1966 students were accepted for study at IKP, Yanovskaya being one of them. Administration's reports highlighted two main channels of employment after IKP: into party journals and newspapers and into "party-pedagogical work", including IKP itself. In 1928 over half of

[5] For further details on those who influenced Yanovskaya's intellectual development and her scholar interests, see (Anellis, 1996).

IKP's faculty was its graduates (David-Fox 1997, 165). It is estimated that almost 25% of IKP graduates continued an academic career.

In the 1930s, higher education and research institutions in the Soviet Union were sufficiently developed. Hence, IKP gradually lost its importance and finally integrated into the system of higher Party schools of the Central Committee of the Communist Party of the Soviet Union.

Yanovskaya's Academic Career

While studying at IKP, Yanovskaya also led seminars on the methodology of science and mathematics at Moscow State University by 1925. In this manner, she came into contact with several prominent Soviet mathematicians.

The need for university professors who could serve the new society was imminent, and Yanovskaya was a promising candidate. Being talented and skilled in mathematics as well as a militant Marxist, she had already earned respect both in academic circles and among her comrades in the Communist Party. Those years, a considerable portion of Muscovite mathematicians were influenced by the so-called "Moscow-school", which had a profound counterrevolutionary and idealistic background. This background was not compatible with what Soviet authorities held that was needed for the training of young Soviet scientists.[6] Yanovskaya portrays a vivid picture of the situation in those years:

> If there is a low percentage of natural scientists sharing Marxist views, then among mathematicians this percentage is even lower [...] the Old Professorship from the so-called "Moscow school", whose authority among the mathematical milieu was unshakable, made every effort to save mathematics from the malicious influence of materialistic philosophy, which did not hide its Party orientation and its class, proletarian character. Even the word "Comrade" was neither accepted at the Institute of mathematics and mechanics, nor at the Mathematical Society [...] in contrast, among the members of this Society, the percentage of white émigrés is rather high. (Yanovskaya 1930, 88, 94)

Accordingly, Yanovskaya was asked in 1926 to teach in Moscow State University's mathematics department, although she was still a student. Being a member of the faculty already for 5 years– and teaching the history of mathematics since 1930 –, she was appointed as a professor in 1931. Simultaneously, she continued her studies and received her doctorate from the faculty of Mechanics-Mathematics of MSU in 1935.

In 1936, she started teaching mathematical logic and in 1943, after the Red Army beat the Nazis, Yanovskaya was appointed Director of Seminar in Mathematical Logic at MSU.[7] As Uspensky notes, she actually founded this seminar, which was the first such institution in the Soviet Union (Uspensky 1997, 459). In 1946, she started teaching formal logic within the Philosophy Department. In 1951, Yanovskaya was awarded the "Order of Lenin", which was the highest national decoration of the Soviet Union.[8]

[6] For a discussion on this complex socio-cultural context and the problem posed to Soviet authorities by the idealistic foundations of Moscow School, see (Kilakos 2018). For a review of Yanovskaya's involvement, see (Levin 2012).

[7] During the war, MSU was temporarily relocated to Perm.

[8] The "Order of Lenin" was awarded to Soviet citizens for outstanding services rendered to the State.

In 1959, Yanovskaya became the first Head of the newly established Department of Mathematical Logic at Moscow State University; she held the Chair in Mathematical Logic until her death in 1966.

Kushner (1991) vividly describes the reminiscences of his first encounter with Yanovskaya in the early '60s, when he attended one of her lectures in the Mathematical School of Moscow University:

> Near the blackboard stood a little old lady in an out-of-fashion black dress (she almost always wore this dress, as I was to learn later). Her face, rather round in shape, was very kind, and big round glasses were in complete harmony with the face. A small, shabby, leather briefcase on the desk was somehow similar to its mistress and completed the picture. All those non-official and old-fashioned attributes immediately charmed me, as well as the very slow and distinct manner in which the lecture was delivered. (Kushner 1991, 67-68)

Bazhanov mentions that it was due to Yanovskaya's efforts that chair in logic and sector of logic were established at Leningrad State and the Institute of Philosophy of the Academy of Sciences of the USSR (Bazhanov 2017, 74).

S. A. Yanovskaya's scientific work

While Yanovskaya is mostly known for her work in mathematical logic and as the editor of the first publication of Marx's "Mathematical Manuscripts", her scientific work ranged in a variety of fields. Her special place in history is not so much due to her original contributions in research, but due to the credit she deserves for making research in mathematical logic possible to others (Uspensky 1997, 459) and her contribution to the promotion of Soviet studies in logic in the 1940s and 1950s[9] (Bazhanov 2001, 4). Yanovskaya contributed to the publication of textbooks, original articles and monographs, and, most importantly, carried out the translation and publication of logical foreign literature (Bazhanov 2017, 74).

Yanovskaya worked on the foundations of mathematics, on mathematical logic and on the philosophy of mathematics and logic (getting engaged with the work of Frege, Russell, Couturat, Cantor, etc.), as well as on the history of mathematics. Among other issues, Yanovskaya dealt with ancient Egyptian and Greek mathematics, Rolle's criticisms of the calculus, Descartes' geometry and Lobachevsky's non-Euclidean geometry.

The titles of some works she published are indicative for the scope of her interests and activities:[10]

- *On the so-called 'Definition by Abstraction'*, 1936
- *On the theory of Egyptian fractions*, 1947
- *Michel Rolle as a critic of the infinitesimal analysis*, 1947
- *The leading ideas of N.I. Lobachevsky - A combat weapon against idealism in mathematics*, 1950

[9] A detailed overview of Yanovskaya's efforts to promote the study of logic in the USSR in the 1940s is offered in (Anellis 1996).

[10] A more comprehensive bibliography of selected works by S. A. Yanovskaya may be found in (Anellis 1987b, 54-55) and in (Levin 2012).

- *On the philosophy of N.I. Lobachevsky*, 1950
- *On the Weltanschauung of N.I. Lobachevsky*, 1951
- *On the history of the axiomatic method*, 1958
- *On the role of mathematical rigor in the creative development of mathematics and especially on Descartes' 'Geometry'*, 1966.

She also published two major studies on the history of mathematical logic in the USSR:

- *Foundations of Mathematics and Mathematical Logic*, 1948
- *Mathematical Logic and the Foundations of Mathematics*, 1959

Of significant importance is Yanovskaya's translating work (mostly in mathematical logic), not only because due to it some important works became known to and utilizable by Soviet scholars, but also because of the interpretative introductions Yanovskaya wrote for them, which are of original scientific importance.

Among other works she translated in Russian, of significant importance are the following:

- D. Hilbert and W. Ackermann, *Grundzüge der theoretischen Logik* (Outlines of theoretical logic – the first foreign book in mathematical logic published in USSR)
- A. Tarski, *Introduction to logic and the methodology of deductive sciences*
- G. Polya, *Mathematics and plausible reasoning*
- R. Carnap, *Meaning and Necessity*
- A. Turing, *Can machines think?*

Yanovskaya's Original Marxist Approach of Modern Mathematics

Yanovskaya's scientific work reflects her aspiration to contribute to the needs of the new society from the standpoint of an academic, militant Marxist and member of the Communist Party. As she acknowledged, this was a difficult challenge: "the goal of stratifying mathematicians and defining the truly Soviet components is a difficult and urgent problem. A problem that demands maximal vigilance" (Yanovskaya 1930, 94). Explaining these difficulties, she further notes that "[t]he modern crisis of capitalism robs mathematics of materialistic tools and methods (intuitionism), widens the gap between theory and practice, and aggravates its spontaneous and unplanned character" (Kolman and Yanovskaya 1931, 118-119).[11]

[11] Ernst Kolman (1892-1979), who co-authored with Yanovskaya this paper, was a leading Marxist mathematician, philosopher and historian of mathematics during the first decades of the Soviet Union. He was a member of the Soviet delegation to the 1931 International Congress of the History of Science and Technology, held in London. Kolman is a rather controversial figure in the history of

Her attempts to address these challenges lead several scholars to describe Yanovskaya as a contradictory figure. This view stems from the inclination of its proponents to juxtapose Yanovskaya's commitment to Marxism and to the interests of Soviet society with the importance of her scientific work.

As a Marxist, Yanovskaya severely criticized idealism[12] in mathematics, which, according to her, was apparent in the works of Frege, Russell, Cantor, etc. Yanovskaya argued that their views were close to true idealism and mysticism, "the example of which is Platonism." According to her, "bourgeois science in the imperialist era does not evolve from Hegel to Marx, Engels, and Lenin, but regresses" (Kolman and Yanovskaya 1931, 119). Her commentary on A. Tarski's work is indicative of her understanding of modern philosophy of mathematics. According to Yanovskaya, he was a logical positivist, representing "the blatant type of philosophical conservatism", as she wrote in the preface to the translation of Tarski's '*Introduction to logic and to the methodology of deductive sciences*'.[13]

As Anellis comments, Yanovskaya, in her writings on philosophy of mathematics and philosophy of logic, "took the offensive against the idealist philosophy of the bourgeois West, represented in her mind by Gottlob Frege, and against the so-called Machism, that is, conventionalism, represented by Rudolf Carnap and his Principle of Tolerance, according to which in logic one is free to choose one's rules" (Anellis 1987a, 82).

In her work, S. A. Yanovskaya proffered a profound analysis of philosophical problems of mathematical logic, which was a troubling issue for Marxists. As Anellis notes, Soviet scholars were facing trouble with drawing a line of demarcation between classical logic and mathematical logic – actually, some of them made no essential distinction between the traditional Aristotelian logic and mathematical logic: to them, both were the hated 'formal' logic (Anellis 1987b, 47).

It is impossible to appreciate Yanovskaya's contribution to its full extent, unless one is aware of the context of the relevant discussion among Soviet scholars. Therefore, the following digression is justified.

The relation between dialectical logic, which is constituent of Marxism-Leninism, and traditional 'formal' logic of the Aristotelian tradition[14] was a compelling philosophical issue for Marxists. Some Soviet Marxist philosophers questioned whether formal logic was

early Soviet science, since he is typically considered as an ideological "watchdog" in scientific issues. However, it is noteworthy that in 1938 Kolman removed from his post as Head of the Department of Science of the Moscow City Committee of the Communist Party. In 1976, Kolman fled to Sweden and gained more fame in the Western world as a Soviet dissident.

[12] A clarification is necessary, since the term 'idealism' is used throughout this paper in the sense it is understood in Marxism, denoting the philosophical views establishing the primacy of mind (or consciousness, or reason) over matter (or reality), as opposed to materialism. This distinction between idealism and materialism bears significant consequences for ontology as well as for the theory of knowledge. For Marxist dialectical materialism, existence in all its forms is material and everything that is real is material and ultimately cognizable. Thus, in this context, idealism is not confronted with realism, since the latter posits the existence of immaterial entities which may or may not be accessible to cognition. Therefore, for example, realistic trends in philosophy of mathematics, rooted in varieties of platonic ideas, are rendered idealistic from a Marxist standpoint.

[13] Bazhanov (2001) offers a different perspective in dealing with Yanovskaya's stance as depicted here, arguing that utterances like those cited here (and by him) resulted from her attempt to compromise with the need to pay tribute to the ideological requirements while at the same time serving the actual needs of an academic community.

[14] In such an account, 'formal' logic could broadly be understood as the traditional logic, developed as an autonomous discipline in the Aristotelian trend, enriched by the contributions of medieval scholars and J.S. Mill's considerations about induction.

bound to its subject matter, due to its pure abstractness. Another hotly debated issue was the relation of logical laws to the laws of reality, which is ever-changing by law-governed processes according to dialectical materialism.[15]

These philosophical questions may seem irrelevant to mathematics. However, they became relevant for Soviet Marxist philosophers, who got worried by the growing interest shown by mathematicians in mathematical logic and the foundational issues of mathematics. According to the current understanding, mathematical logic developed as a discipline, spinning-off from formal logic. Its roots were traced back in the second half of the 19th century when rigorous mathematical methods were introduced in the study of logic and symbolic notations were extensively used in logical reasoning. In the view of many Soviet philosophers, mathematical logic was merely a new phase of formal logic, the latter being understood as an incomplete approach to the study of the laws of thought.

On these grounds, philosophers and mathematicians were engaged in thorough discussions on whether logic is a philosophical discipline or a special branch of mathematics. Those who argued that logic is a philosophical discipline felt rather uncomfortable with dealing with mathematical logic as logic. In fact, several Soviet philosophers dismissed mathematical logic as being of mathematical interest only and perhaps not even logic at all.

In this discussion, Lenin's strictures against 'idealism' and 'formalism' were used to render mathematical logic 'idealistic' and hence incompatible with Marxism-Leninism. The following passage exemplifies the hostile attitude of a portion of Soviet Marxist philosophers:

> The mathematization of logical relations and operations, and the rise of logical calculi, is one of the sources of idealistic delusion and speculation on the interpretation of thought and the process of cognition, just as the mathematization of physical relations was one of the reasons for the appearance of 'physical idealism'. (Vojsvillo et al. 1959, 176)

The content of these disputes very little in common with today's discussion about the various positions in mathematical logic. Therefore, it may surprise those who are unfamiliar with Soviet Marxists' critique of philosophical idealism. However, these discussions are substantial, since, as Bochenski rightfully notes, "not only because they might bring some new insights in this difficult field, but also for the understanding of what is happening in Soviet philosophy" (Bochenski 1961, 34). While Soviet philosophy is not the primary focus of this paper, one should take into account with regard to mathematics that in Yanovskaya's times, these problems, "which were elaborated in hard struggle by Soviet logicians, have never been sufficiently studied, from the modern point of view, by any school of Western logicians" (Bochenski 1961, 33). Thus, albeit the quite idiosyncratic employment of various terms and "-isms" in these discussions, one should bear them to understand Yanovskaya's pivotal role in the development of mathematical logic Soviet Union.

To perform this role, Yanovskaya should defend mathematical logic against the misconceptions of those who confused it with the philosophy of mathematics (Anellis 1987b, 47), in which idealistic trends were prevailing. She concisely deploys her views on this issue in a letter to the editors of the highly appreciated Soviet philosophical journal 'Voprosy Filosofii' (Yanovskaya 1950). In this letter, Yanovskaya argues that logic is not a special mathematical discipline; it is merely logic. In this argumentation, Yanovskaya endorses the view expressed by Stalin in his 'On Marxism and linguistics' (1950) on the

[15] For a concise yet detailed discussion of this discussion from an anti-Marxist perspective, see (Wetter 1958, 523-535) and Bochenski (1961).

distinction between language and linguistics. Hence, Yanovskaya implies that Stalin's line of reasoning supports her view that mathematical logic should be unconfused with the philosophy of logic or philosophy of mathematics.

It should be noted that Yanovskaya consistently employed this solid view throughout her work – even before Stalin deployed his views on linguistics. For example, she argued for the distinction between the methodological formalism of mathematical logic and the idealism of the formalist philosophy of mathematics, since mathematical logic "can be considered not only as logic of mathematics but also as mathematics of logic, for it is in large part the result of the application of mathematical methods to the problems of logic" (Yanovskaya 1947a, 341).

In the context as mentioned above, Soviet scholars attempted to set up a historical and philosophical study of mathematics based on Marxist dialectics, as A. N. Kolmogorov writes in the entry on mathematics in the *Great Soviet Encyclopedia* (Kolmogorov 1938, 394). Despite its significance, a study on the foundations of mathematics and mathematical logic was an arduous task for Soviet Marxists theorizing on mathematics. Logicism,[16] which was one of the most influential currents for the development of modern mathematics, was rejected by Marxist scholars, who argued that it reduced mathematics to a branch of formal logic, fully detached from the dialectics of practical life and existential conditions (Vucinich 1999, 108). It is reasoning, based on an absolute reign of symbolism, was criticized as "a shortcut to solipsism", as Bammel wrote (Bammel 1925, 57). In short, Soviet Marxists used to accuse logicism of its emphasis on rules and formulas devoid of any specific content. This attitude was extended to several other trends oblivious to content, since –as it was argued- they could not reflect reality. In this line of reasoning, operating on forms without any content inevitably leads to philosophical idealism. Ergo, this kind of mathematics was incongruous with the acute methodological needs of science and the technical needs of society, amid vast transformative process on both domains. As Vucinich notes, Soviet mathematicians "in contrast to Marxist theorists, showed a clear tendency to refrain from any effort to interpret their science in the light of dialectical materialism" (Vucinich 1999, 111).

From a philosophical standpoint, the troubling issue was the accommodation of formal logic within the broader scope of dialectical logic. According to dialectical materialism, formal logic is not capable of grabbing the essence of reality in its motion and its reflection on our understanding and knowledge. At best, formal logic may offer rules for logical inferences and reasoning with fixed concepts and judgments – actually, it is indispensable when one is dealing with such kind of problems. Therefore, any attempt to render mathematics founded on the grounds of formal logic was, in Marxist understanding, detaching them from reality, something unacceptable.[17]

As one would expect, Yanovskaya was aware of this Marxist critique regarding mathematical logic. She held the view that modern science (including mathematics) should be demystified by the idealistic presumptions guiding its development in capitalist

[16] Logicism in philosophy of mathematics tried to define the basic concepts of mathematics by means of logical terms, or, to put it differently, to infer all mathematics from some logical terms. It was grounded on the Kantian doctrine, according to which the truths of logic are paradigm cases of analytic truths, being true only by virtue of internal relations among the linguistic (and mathematical, in the case of mathematics) expressions involved. For a concise yet detailed discussion on logicism and neologicism (the distinction between them is beyond my concerns in this paper), see (Tennant 2017).

[17] For a summary of the main points of contention in the debate between the dialecticians and the formal logicians, see (Cavaliere 1990) and (Anellis 1994).

countries. However, she firmly believed that knowledge of mathematical logic is indispensable for Marxist mathematicians and philosophers. As Yanovskaya explains in her preface to the Russian translation of D. Hilberts's and W. Ackermann's *Grundzüge der theoretischen Logik,* ideological struggle with idealistic perversions of bourgeois science presupposes a command of techniques that enable one to swing the enemy's weaponry against himself" (Yanovskaya 1947b, 6).

Retaining this view of the matter, Yanovskaya argued on the compatibility of dialectical materialism and mathematical logic. Küng (1961, 39-41) concisely reconstructs her argumentation. By referring to the incompleteness of every formalization as demonstrated by Gödel, Yanovskaya refuted the formalist conception, which treats mathematics as a mere abacus. According to her, the principle of non-contradiction of formal logic could be reconciled with the dialectical conception of the contradictory nature of reality. As she argued, an interpreted axiomatic system can be contradictory unless one undertakes precautionary measures concerning the formulation of the axioms and the applicable means of logical deduction. The trouble, then, is only until any particular question is concretely formulated. If one manages to reach to such a formulation – a course which is guided by dialectic principles – then there is only one, completely determined and unambiguous, answer to the question under study. Thus, actually, Yanovskaya pointed to the fact that dialectical logic is about how any dialectical contradiction, being inherent in reality and reflected on the intellect, is resolved. As she further underscored, "a dialectical contradiction has nothing in common with formal-logic contradiction" (Yanovskaya 1959, 118).

Moreover, Yanovskaya emphasized on the fruitfulness of the application of mathematical logic in mathematics and cybernetics and stressed on the connections of mathematical logic with its technical applications. According to her, there was a significant development in the field of mathematical logic in the first half of the 20th century due to the rapid development of computational techniques, to which it contributed (Markov, Kuzichev and Kuzicheva 1996, 5). Thus, focusing on relevance with real-world and problems of substantial economic interest, S. A. Yanovskaya disentangled the advancement of mathematical logic from the philosophical discussion on the relation between formal and dialectical logic. In fact, she proceeded even further, portraying the foundations of mathematics as an issue of interest in the advancement of socialism. As she explicitly stated in her contribution for the book *Struggle for Materialistic Dialectics in Mathematics* (1931), "[t]o give a [sound] foundation to mathematics means to rebuild it based on theoretical understanding of the practical problems of constructing Socialism" (cited by Lorentz 2002, 185).

Several scholars who have dealt with Yanovskaya's work (i.e. Bazhanov, Anellis, Kushner, etc.) hold that Yanovskaya's adamant Marxist critique against the idealistic formalism and logicism was a tactical move, serving her purpose to contribute to the establishment of mathematical logic as a discrete discipline in the Soviet Union. However, I maintain that such an understanding diminishes the importance of Yanovskaya's contribution.

As I understand her work, Yanovskaya was striving to proffer an original Marxist understanding of modern mathematics. Besides mathematical logic, this also holds for other fields of mathematics she also worked on –among others, for example, in her interesting deployment of a Marxist view of the infinitesimal calculus. According to Yanovskaya, real analysis is understandable as the algebra of motion or the "mathematics of a variable quantity [which] must be of an essentially dialectical character" (Yanovskaya 1983, XI).

The proposed understanding of Yanovskaya's attitude towards mathematical logic is arguably omnipresent in her writings. For example, in her (1948), Yanovskaya declared that

Soviet mathematicians rejected the view that mathematical propositions say nothing about reality. To support this claim, Yanovskaya pointed to A.N. Kolmogorov's work on intuitionistic mathematics, sharing with dialectical logic the rejection of the Law of Excluded Middle. In her view, the problems faced by mathematical logic and its philosophical interpretation could be responded by the development of constructive logic, in which, for example, the Law of Excluded Middle is rejected. Accordingly, Soviet logicians should axiomatically develop constructive logic while discarding the idealistic philosophy adjoint with Brouwer's intuitionistic logic. In order for this task to be performed, according to Yanovskaya, work should be done on extending the laws of the logic of finite domains to infinite domains. On this line of reasoning, other principles of formal logic, i.e. the Law of Non-Contradiction, could also be eliminated. Notably, if such an attempt proves to be successful, then it would be compatible with dialectical logic. Furthermore, as Yanovskaya argued, Soviet logicians also responded to the logical paradoxes, by developing multi-valued logic (for a detailed discussion on these issues and Yanovskaya's argumentation, see Anellis 1996). Prominent Soviet mathematicians, such as A.N. Kolmogorov, V.I. Glivenko, A.A. Markov, D.A. Bochvar, P.S. Novikov, M.I. Sheinfinkel (Schönfinkel) etc., worked along these lines. It should also be noted that plenty of them were participating in the seminar on mathematical logic in MSU, organized and directed by S. A. Yanovskaya.

The Adventure of Marx's Mathematical Manuscripts

Undoubtedly, one of the most significant milestones in Yanovskaya's fascinating life and career is the fact that she was the editor of the first publication of K. Marx's "Mathematical Manuscripts" in 1933. Let us focus on this milestone. An obvious question that one may ask is why these manuscripts remained unknown and inaccessible to scholars for such a long time after his death. In fact, the story of editing and publishing Marx's Mathematical Manuscripts is a rather adventurous one.

After Marx's death in 1883, these manuscripts passed into Fr. Engels' hands, who unfortunately did not have the chance to publish them. After Engels' death, the entire collection of papers by him and Marx passed into the hands of the German Social Democratic Party (SPD), without any plan for their publication. The Great October Socialist Revolution in Russia in 1917 and the birth of the Soviet State renewed the interest in unpublished work of the classics of Marxism. The manuscripts were discovered in SPD archives by D. Ryazanov, the founding director of the Marx-Engels Institute, who created 'MEGA' (Marx-Engels-Gesamtausgabe) aiming to publish the complete works of Marx and Engels. Ryazanov was rather surprised to discover that many Marx's notebooks were devoted to mathematics, amounting to 865 A4 sheets in very small writing. He photographed them and stored them in the Marx-Engels Institute.

The first attempt to edit them in order to be published was assigned by Ryazanov to E. J. Gumbel, but the result was found insufficient by the new leadership of the Institute under V. A. Adoratskii; thus, this first attempt did not lead to a publication. In 1932, the task was reassigned to a group of mathematicians led by S. A. Yanovskaya – the other members of the group were D. Raikov and Nakhimovskaya.[18] Thus, it was only in 1933 that a selection of them appeared for the first time in public, in Russian translation, in the pages of the magazines *Under the Banner of Marxism* and *Markismi Estestvoznanie*. Yanovskaya also wrote a commentary introduction entitled "On the Mathematical Manuscripts of K. Marx".

Although the complete edition of Marx's Mathematical Manuscripts was expected to take place quickly after the 1933 publication, the outburst of WW2 posed a necessary

[18] For a detailed discussion of this story, see (Alcouffe and Wells 2009).

change of plans. The archives and the library of Marx-Engels Institute were shifted from Moscow to the Far East in order to be secured and did not return to Moscow until the Red Army beat the Nazis. Up to then, S. A. Yanovskaya, who remained in charge of the endeavor was also heavily engaged with her work in mathematical logic. In the 1950's, the appointment of K.A. Rybnikov as her assistant for the edition of Marx's Mathematical Manuscripts seemed to provide a good opportunity for the acceleration of the project, but unfortunately until the end of the decade it appeared only the publication of a note entitled "On The Concept of Function" in the journal *Voprossy Filosofii* (No. 11, 1958). While Yanovskaya died in 1966, her contribution in work done to prepare the complete and annotated publication that finally appeared in 1968, in facsimile and also in Russian and German, was immense.

The present paper is not the appropriate venue to discuss in detail Marx's mathematical reasoning, the influences it portrayed[19] and its relative position in Marxian work. However, I maintain that a hint could be given, to underline the scope of the work done by Yanovskaya not only for the publication of the manuscripts, but also on a thorough study of Marx's perspective on mathematics.

Historical surveys have discovered that Marx's interest and studies in mathematics covered a long period from the late 1850s until the early 1880s and his death. Yanovskaya (1968) notes that Marx's formal studies in mathematics were oriented around the texts that Cambridge students used during this period. Concerning Marx's influences on his mathematical studies, Kol'man and Yanovskaya (1931) stressed the influence of Hegel's *Science of Logic*. Among the several issues they raise, they discuss in particular the issue of Hegel's notion "quantitative infinities". The relation between Hegel's intuitions in *Science of Logic* and Marx's studies on mathematics was also noticed by Engels, who, in a letter, he wrote to Marx notes:

> So old Hegel was quite right in supposing that the basic premise for differentiation was that most variables must be of varying powers and at least one of them must be the power of at least 2 or 1/2. Now we also know why. (Marx & Engels 1992, Collected Works, vol.46, p. 131)

In fact, Engels was so enthusiastic about Marx's interest in mathematics that in a letter he wrote to Lange in March 1865 mentions that the only man who has enough understanding of mathematics and philosophy to be able to edit the mathematical manuscripts that Hegel left behind, was Marx (Marx & Engels 1987, Collected Works, vol. 42, p. 138).

One could barely imagine the impact of the publication of Marx's Mathematical Manuscripts for militant Marxist mathematicians in the early 1930s and what it reflected for the status of the editor of this publication. Given the discussion in the previous section, Yanovskaya's career before and after the publication proves that she was able to bear the burden of responsibility.

Wittgenstein in Moscow

One of the most intriguing (especially for the Western reader) episodes in Yanovskaya's career was her encounter with L. Wittgenstein when he visited Moscow in 1935, almost a year and a half after the first publication of Marx's Mathematical Manuscripts.

19 For a concise yet detailed and well-informed discussion on Marx's writings in mathematics and his influences, see (Matthews 2002), on which I have relied for large parts of this section. Perhaps the most classical paper on the issue is (Struik 1948).

When his five-year Research Fellowship at Trinity College expired, Wittgenstein was looking for the next step in his career. Among other career-paths, he considered, one of particular interest was the possibility of taking up a career in a Soviet academic institution. Although such interest may seem peculiar to a modern reader, the fact is that Wittgenstein's interest in Soviet Russia was not an instant impulse. In fact, the idea of visiting Soviet Russia was occurring in Wittgenstein's mind for quite a long time, since he first wrote about it to a friend in 1922 (Moran 1972) and he had been taking lessons in Russian since 1933. In order to arrange his travel to USSR, Wittgenstein asked J.M. Keynes to introduce him to the Soviet ambassador in London, I.M. Maiski. The travel was finally arranged and on September 12, 1935, Wittgenstein arrived in Leningrad, from where he traveled to Moscow, arriving there on September 14. After spending almost two weeks in the Soviet Union, Wittgenstein returned to Cambridge on October 1, 1935.

Yanovskaya was assigned by Soviet authorities to curate Wittgenstein's stay in Moscow. It is not difficult to think about why she was chosen for that. It is obvious that having such a highly-esteemed visitor from the West, Soviet authorities should assign someone suitable to accompany him. Yanovskaya was an excellent candidate for this task, for several reasons. At first, her partisanship and her commitment to the Soviet state and the Communist Party could not be put into question. Furthermore, she was well aware of the challenges that Soviet academia faced, after its reorganization in the first decades after the Revolution and could convincingly discuss this situation with a Western intellectual of Wittgenstein's caliber. Moreover, even if there is no record that I know of about her possible prior engagement with Wittgenstein's work, the fact that she had studied logical empiricism/positivism and the Marxist critique thereof, made her capable of thoroughly discussing with Wittgenstein on philosophical issues of his interest. Finally, one should not disregard that Wittgenstein's no-content theory of logic in the *Tractatus* was tantalizingly suggestive about how mathematics could be integrated into an overall empirical theory of the world, as Creath (2017) notes. On this particular issue, Yanovskaya had devoted much of her work.

The majority of the scholars who have dealt with Yanovskaya's work and Wittgenstein's visit in Moscow claim that Yanovskaya persuaded him to give up the idea of relocating to Moscow. However, sources close to Wittgenstein offer a different perspective. According to them, Yanovskaya not only did not dissuade him from staying in USSR, but actually (obviously on behalf of Soviet authorities) offered him a job. As Monk recollects from his conversations with Wittgenstein, Yanovskaya recommended Wittgenstein for the Chair of Philosophy at Kazan University (Lenin's old college), as well as for a teaching post at Moscow University (Monk 1990, 351). Cornish also reaffirms the job offer for Kazan University (Cornish 1999, 73-74).

According to the same sources, Wittgenstein and Yanovskaya were impressed by each other, had interesting discussions and continued their correspondence even after Wittgenstein's departure from Russia. Moran (1972), who managed to contact and then elicit several comments from some of the Russians involved in Wittgenstein's visit to Moscow, reports A. Soubotine from the Institute of Philosophy recalling a conversation with the Yanovskaya, who said that Wittgenstein impressed her favorably with his friendly simplicity, that he showed an interest in dialectical materialism and that she gathered from their conversations that he was interested in Soviet philosophic thought and followed its development. Moran also refers to G. H. von Wright, one of Wittgenstein's literary executors, who remember Wittgenstein talking about his meeting with Yanovskaya, "a likable woman philosophy professor". It seems that the conversations between Wittgenstein and Yanovskaya were charming and philosophically interesting. According to them, Yanovskaya advised Wittgenstein to "read more Hegel" (Monk 1990, 351, and Rhees 1984, 209). After his return from Moscow, Wittgenstein continued to correspond with

Yanovskaya and, as Monk further informs us, when he went away to Norway, he arranged with Fania Pascal for Yanovskaya to be sent insulin for her diabetes" (Monk, 1990, 347).

It follows, then, that Yanovskaya not only managed to gain Wittgenstein's respect for her intellectual status and character, but they also developed a friendship. This is certainly indicative of the caliber of Yanovskaya's personality.

To Sum up

Zinov'ev rightfully characterizes S. A. Yanovskaya as "the pioneer of the discussion of the philosophical problems of modern logic" in the Soviet Union, including "the relationship between constructive and non-constructive methods, the introduction and removal of abstractions of higher orders, the application of the criteria of practice to logic and others" (Zinov'ev 1968, 212). The profoundness and the impact of her contribution justify the assessment that Yanovskaya founded a distinct "school in history and philosophy of mathematics and mathematical logic" (Kushner 1996, 67). Research on the work of this school and the context in which it developed is an issue of significant interest. Future research may focus particularly on the impact of the socio-cultural context within which this school proffered its contributions. It may also inform a more profound understanding of how and why this context favored the emergence of woman as a leader of a distinct school. Furthermore, an issue that deserves further research is the impact of Yanovskaya's leading role on the status of women in the philosophical, mathematical and logical community in the Soviet Union.

In this paper, I have attempted to trace the impact of the complex socio-cultural context of the first decades of the Soviet Union on Yanovskaya's intellectual course and academic career. Contrasting other scholars who argue about a purported schism between the "political" and the "scientific" life of Yanovskaya, I argue that her work in its totality was informed by her solid commitment to militant Marxism and her persuasion that she could contribute to the building of the new society by performing her duties as a member of Soviet academia and as a member of the Communist Party.

Regardless of the success of my argumentation, I hope that I have at least managed to show that Yanovskaya's fascinating life and work deserves more scholar attention than it has already drawn.

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