Robin Burton

HPSC3040: ESSAY

Mathematics and Mathematicians in the Stalin era of The Soviet Union

The communist revolution in Russia brought with it a push to bring philosophical and scientific practice into line with Marxist theory, dialectical materialism and socialist construction. This effort came into force with increased zeal during the Stalin era of the Soviet Union (Vucinich, 2000). The western tradition of mathematics as a 'pure', theoretical, isolated and institutionalised discipline, along with the increased domain of theoretical mathematics over the physical sciences, began to be seen as a direct threat to Communist party loyalty, Marxist ideology and the socialist cause. On the surface, history suggests that institutions and mathematicians favourable to western developments in mathematics such as set theory, were subject to intense criticism, replacement and purges. Nevertheless, great strides were made in mathematics during the period, and some scholars even refer to this period as the "Golden Era" of soviet mathematics (Zdravkovska & Duren, 1993, Lorentz, 2002, pp.170, 197). This essay will examine the socio-political conditions under which soviet mathematicians operated and attempt to explain how they were able to produce ground breaking work in otherwise stifling conditions. In doing so, the trial and persecution of soviet mathematician Nikolai Nikolaevich Luzin will be explored and contrasted with the successful lives and mathematical careers of Pavel Sergeyevich Aleksandrov and Andrey Nikolaevich Kolmogorov. Additionally, parallels will be drawn with other prominent and successful soviet scientists such as Vladimir I. Vernadskii, highlighting similarities between their methods and philosophies and how they were able to survive in the Stalin era. It will be shown that, although indeed subject to intense criticism, political demands and potential persecution, the relationship between Stalin, the state and mathematicians was all together far more nuanced and complex than is immediately apparent. As exampled by Luzin, Aleksandrov, Kolmogorov and Vernadskii, factors such as political pandering, application of research, selective application of state power and the

economically favoured position of mathematics could mean the difference between privilege and persecution.

Before proceeding with the main text of this essay, the basic definitions of Marxist theory, Dialectical Materialism and Socialist Construction will be explained. These were key elements of the Soviet philosophy and will be frequently referenced within this essay. Marxism is a body of political and economic doctrines developed by Karl Marx and Friedrich Engels (Encyclopaedia Britannica, 2017). The basic theory of Marxism is that history is one of class struggle. It argues that under capitalism, land and property holders called the bourgeoisie own the means of production and exploit the labour of working class, called the proletariat. Marx theorised that capitalism would inevitably collapse as the proletariat revolt against the bourgeoisie, making way for socialism and eventually a classless communist society without property or capital. Communism may be considered the practice of Marxism. Marxism was the basis for the operation of the state in the Soviet Union. Soviet Marxism was developed by Vladimir Lenin, modified by, and eventually reached its totalitarian apex under Joseph Stalin. Also called Stalinism, this modification of Marxism was characterised by brutal enforcement of communist policy, elimination of political dissidents, and the application of Marxist philosophy to all areas of science, society and industry (Encyclopaedia Britannica, 2013). While communism is the practice of Marxism, the theoretical foundation of Marxism is Dialectical Materialism (Encyclopaedia Britannica, 2016). In basic terms, Dialectical Materialism is a philosophy of the nature of reality, encompassing thoughts, emotions, society and the material world. It challenges the conception of matter and philosophy as independent from human concerns. In terms of how this applies to science and mathematics, dialectical materialism "…insists on the approximate relative character of every scientific theory of the structure of matter and its properties; it insists on the absence of absolute boundaries in nature…" (Lenin, 1964). Finally, Socialist Construction refers to the construction of society at all levels toward the Marxist socialist model (Trotsky, 1973). This became increasingly ruthless under Stalin and included planning of education, re-education, technology and science toward party goals. Further explanations of how these factors apply will be given in context as they apply to the subjects of this essay.

Although the main focus of this essay is set within the Stalin era (1928-53), it is first necessary to address the social and ideological conditions preceding this era. Although vigorous and

oppressive application of Marxist theory to science and mathematics is associated with Stalin, it can be seen that the foundations of this movement were setting from the time of the revolution onward. According to Alexander Vucinich, although there existed an active Marxist critique of western mathematical idealism, and desire to bring mathematics into line with dialectical materialism, this largely failed to materialise into during this period (Vucinich, 1999). This was for a number of reasons. Firstly, although Marx, Engels and Lenin had warned about physical idealism and the isolation of mathematical theories from social values, they did not provide a direct critique of 'modern' developments in mathematical theory from which to draw from, delaying intensive focus on the field and granting mathematicians considerable freedom for a period of time (Vucinich, 1999, p.107). Furthermore, western developments in mathematics, such as set theory, were very new and had yet to extensively penetrate the soviet education system. Because of this, consensus against mathematical idealism had yet to be established, and Marxist critiques that did exist were primarily directed at the west itself as opposed to internally. Secondly, even once Marxist theoreticians began to research and publish on the topic of mathematical philosophy, this period was characterised by broad areas of disagreement and factionalism on how to, and whether or not they should, apply Marxist theory to mathematics (Vucinich, 1999, pp.108-113). This disunity granted mathematicians a high degree of autonomy and ideological freedom, and allowed them to make great advances in mathematics. Nevertheless, it was in the pre Stalin period that Marxist arguments against western 'mathematical idealism' and the mathematisation of science were established. Throughout this period, the Bolshevik authorities strived to increase their control over the scientific community (Vucinich, 1999, pp.121-122). By the mid to late 1920's, they had already begun to outlaw journals 'incompatible' with Marxism and supporting idealism, and mathematicians in suspected institutions began to be replaced by newly trained members screened for their loyalty to the Communist party and ideology. Primacy of Marxist philosophy and control of all fields of science and mathematics was the goal, setting the stage for Stalin's extreme implementation of this policy.

Beginning in the early 1930's of the Stalin era, arguments for a Marxist interpretation of science solidified, and key figures of this movement began to unify in their opposition to isolated, institutionalised 'idealist' mathematics. The Mathematical section of the Communist Academy, previously the Socialist Academy, lead the ideological attack on soviet mathematicians and outlined demands for the entire field of theoretical mathematics and physics to be brought under control of the state, and in service to dialectical materialism and

party loyalty (Vucinich, 2000, pp.54-55). Two key figures in the escalation of communist control over mathematics and the sciences were Ernst Kolman and Sofya Aleksandrovna Yanovskaya. Ernst Kolman was a confidant of Lenin and became president of the Moscow Mathematical Society from 1930 to 1932 and deputy head of the Moscow party Science Department in 1936, assuming the role of chief ideological watchdog in the science community (Graham, 1993, New York Times, 1979, Vucinich, 2000, pp.54-56). In 1931, Kolman charged that 'wreckers' were attempting to restore capitalism, corrupt Soviet physics and discredit dialectical materialism, warning that it was time for Marxists to recognise that the "most harmful and dangerous of all things is empty, naked theoretization" and that "there is no more impenetrable mask to hide behind than a curtain of mathematical abstraction" (Graham, 1993, p.148, Kol'man, 1931). He argued that mathematics must be absolutely integrated with dialectical materialism and put into service of soviet politics and socialist construction (Kol'man, 1930, Pontriagin, 1934). Sofya Aleksandrovna Yanovskaya was herself an accomplished mathematician, and is recognised today for her contributions the history of mathematics and to the study of mathematical logic (Bashmakova et al., 1966, O'Connor & Robertson, 2006). Yanovskaya had originally studied mathematics at the Higher School for Women in Odessa in 1915 and became politically active during the Russian Revolution, joining the Bolshevik wing of the Russian Communist Party, acting as political commissar to the Red Army, and as an editor for the *Kommunist* newspaper in Odessa. In 1923, she returned to her mathematical studies, teaching at the Institute of Red Professoriate and achieved her doctoral degree in 1935. Through her many works on the history and philosophy of mathematics, she rose to prominence as a leading scholar, Marxist spokesperson and critic of idealist institutionalised mathematics in the Stalin era (Vucinich, 2000, p.57). Irving Annellis writes that it was through Yanovskaya's writings that "she took the offensive against the idealist philosophy of the bourgeois West" (Annellis, 1987). A key text in the escalation of communist policy over mathematics was her interpretation of Marx's "mathematical manuscripts" in 1933, in which she asserted that Marx opposed all forms of idealism and isolation of mathematics (Marx, 1983, Yanovskaya, 1933). Through her own works and her interpretations of Marxist philosophy on mathematics, she helped to establish a soviet tradition in mathematics, whilst also providing a foundation and rallying point around which many other Marxist and Stalinist actors closed ranks and moved to assert control over mathematics and the mathematisation of science (Vucinich, 2000, p.58).

Although certainly not forming the totality of Marxist and Stalinist arguments at this time, Vucinich places great emphasis on the arguments of Kolman and Yanovskaya in his analysis of the developments toward the ideological oppression of mathematicians in the Stalin era. He writes that, where previously in the 1920's Marxist theorists avoided direct attacks on individual mathematicians, in 1930's these attacks were commonplace and part of a direct Stalinist policy aimed at "weakening the intelligentsia by means of a frontal attack on independent thought, automatically regarded as a direct challenge to the basic premises of Marxist philosophy" (Vucinich, 1999, pp.107-124, Vucinich, 2000, pp.58-59). This reached its peak during the Great Purge and is 'exemplified' by the Luzin affair. The Great Purge began in 1936, during which millions of people were arrested, sent to labour camps or executed for suspected disloyalty to the Communist party (Figes, 2007). This included leading members of the intelligentsia, science and mathematical community. Under Stalin, dialectical materialism was used to "terrorise" scientists accused of idealism or "bourgeois" science, whom were publically shamed, humiliated, demoted or prosecuted (Graham, 1993, pp.121-122). The Luzin affair occurred in the first year of the purge of 1936, during which mathematician Nikolai Luzin was repeatedly attacked and criticised in the official Communist Party newspaper *Pravda,* which was later attributed to Ernst Kolman (Levin, 1990). Nikolai Nikolaevich Luzin was an accomplished pre-Stalin soviet mathematician, known for his work on set theory and mathematical analysis, and taught a number of successful soviet mathematicians (O'Connor & Robertson, 1999). The repeated attacks on Luzin eventually culminated in a trial by Commission of the Academy of Sciences of the USSR accusing him of deliberately corrupting the education system, publishing poor papers in Russia and quality papers abroad, stealing his best work from his party loyal students, concealing his anti-Soviet beliefs and supporting tsarist monarchy and Orthodox Christianity (Lorentz, 2002, pp.203-205). For these apparent crimes, he was removed from all of his official positions in the institutions, and his department in the Steklov Institute was closed down. Although a relatively lenient punishment, the Luzin affair highlights the extreme ideological and political pressures under which mathematicians operated during the Stalin era.

Nevertheless a number of mathematicians made great strides and contributions to mathematics during the Stalin era, including subjects within mathematics considered idealist, anti-Marxist and 'opposed' to dialectical materialism. In fact, the progress made in this era was so great that it is sometimes referred to as the "Golden Era" of soviet mathematics (Zdravkovska & Duren, 1993, Lorentz, 2002, pp.170, 197). Given the ferocity with which many mathematicians were

persecuted during this time, this might appear paradoxical. However, further investigation reveals a number of ways in which these mathematicians managed to avoid the brunt of persecution, whilst hinting at the true motivations of Stalin, the state and the selective application of oppressive state policy. Of particular interest in this essay are Pavel Sergeyevich Aleksandrov and Andrey Nikolaevich Kolmogorov. Aleksandrov and Kolmogorov were close friends, and students of Luzin (O'Connor & Robertson, 1999). Investigating why they 'succeeded' within the soviet system, where Luzin did not, reveals a number of clues.

P. S. Aleksandrov was a Professor of mathematics as Moscow University from 1929, corresponding member of the Soviet Academy of sciences from 1929 and president of the Moscow Mathematical Society from 1932 to 1964 (Yakov, 2003, pp. 223-225.). He wrote over 300 papers and received many honours, including five Orders of Lenin and the Stalin prize in 1943. This formed part of a successful mathematical career that spanned the entirety of the soviet era. He is most famous for his important contributions to set theory and topology, of which the Alexandroff compactification and Alexandrov topology are named after him (Encyclopaedia Britannica, 2017[B]). Likewise, A.N. Kolmogorov was one of the most successful and accomplished mathematicians of the soviet era, going on to make significant contributions to modern mathematics in a number of fields, including probability theory, topology, classical mechanics, intuitionistic logic and turbulence (Yakov, 2003, pp.323-325, Parthasarathy, 1988). Like Aleksandrov, Kolmogorov also received a number of honours including the Stalin prize, a Lenin prize and a Lobachevsky Prize (Encyclopaedia Britannica, 2006). Importantly, the large part of both Aleksandrov and Kolmogorov's work was in fields of mathematics that, as we have seen, should have been extremely problematic to Marxist philosophy and Stalinist policy at the time. Most obvious of which is set theory. How then, did they go on to be so successful in these fields, where others such as Luzin did not?

Vucinich argues that both Aleksandrov and Kolmogorov, although not personally invested in the application of dialectical materialism to mathematics, nonetheless appeased the Marxist and Stalinist inquisitors by 'couching' their research (Vucinich, 2000, pp.60-62). Aleksandrov indirectly defended the isolation of set theory by appealing to its use as a 'tool' or 'apparatus' which, when correctly handled, could open to paths to knowledge of "systems of relations" (Vucinich, 2000, p.60). In this way, Aleksandrov satisfied the Marxists by relating set theory directly to the study of the material world. Similarly, Kolmogorov positioned himself as a supporter of the ultimate superiority of dialectical materialism and Marxism, allying himself

with Marxists writers, and espousing the benefits of his work in the "dialectical development of mathematics" (Vucinich, 2000, pp.61-62). Although Vucinich describes Kolmogorov's allegiance to Marxist theory as "fortuitous and superficial", he argues that this was enough to satisfy the Marxists.

Appeasement to the soviet authorities was most certainly a factor in their success, and was a strategy common to other scientists during this period. Another such example can be found in the case of Vladimir Ivanovich Vernadsky, a successful Russian Ukrainian mineralogist and geochemist during the Stalin Era. Professor of Soviet History Kendall E. Bailes attributes Vernadsky's survival and success largely to his strong advocacy for the application of theoretical science to the needs of the soviet economy and national defence (Bailes, 1986, p.25). These tactics, common to Aleksandrov, Kolmogorov and Vernadsky, appear to explain the persecution of Luzin, who was described by Sofya Yanovskaya as having no interest in the practical application of mathematical theories (Vucinich, 2000, p.27, Yanovskaya, 1930). However, given that the accusations brought against Luzin were largely circumstantial and that he does not appear, at least, to have been overtly anti-Soviet, these reasons alone may be too simple.

G. G. Lorentz, himself a mathematician during the Stalin era, emphasises a different line of reasoning. Although acknowledging successful mathematician's deferral to Marxist authority at this time, he argues that, ultimately, the relative freedom and autonomy of mathematics was due to its privileged position in the eyes of Stalin and the state (Lorentz, 2002, pp.197-199). Lorentz reports that Lenin, Stalin and the communist party had great respect for mathematics and the physical sciences as they believed that the future of communism was ensured by it (Lorentz, 200, p.198). This is why the attacks by Marxist spokespersons such as Kolman had little effect on the output of successful soviet mathematicians. Mathematics was especially privileged by the communist party, as it inherently offered many practical applications, whilst being difficult to plan. Compared to other endeavours, mathematics was a relatively inexpensive field. It was also relatively apolitical. Furthermore, competent mathematics teachers were always in high demand by technical high schools and polytechnical institutes. This would seem to suggest that mathematics and mathematicians, rather than being oppressed under Stalin, were actually supported and allowed to flourish. This would also account for the success and progress that was made in mathematics during this period. Nevertheless, the Luzin

case shows that they were certainly not immune persecution. But if not for the content of mathematics itself, the question of why some mathematicians were persecuted remains.

Returning again to the Luzin case, Semën Samsonovich Kutateladze and Lorentz analysis of the trial reveals a number of clues. Kutateladze argues that the attack on Luzin was formed of two parts, one motivated by the interpersonal and generational conflict between Luzin and his students, and the other motivated by the desire of state the state to make an example of him (Kutateladze, 2007). In the first instance, Luzin's students were highly active in the trial, chief of which was P.S Aleksandrov. However, the primary accusations brought against him by Aleksandrov and others students was that of academic weakness, plagiarism and taking credit for their work (Kutateladze, 2007, p.2, Lorentz, 2001, p. 30-32). Aleksandrov asserted numerous times that Luzin was not anti-Soviet and had made no anti-Soviet statements (Vucinich, 2000, p.203, Lorentz, 2001, p.32, 206). In the second instance, Kutateladze claims that Luzin served as an "exemplary outcast" for Stalinism and the state, and that the charges brought against him were vastly exaggerated, although he does not explain exactly why (Kutateladze, 2007, p.9-10, 12). Nevertheless, Luzin's trial was not only unusual to be brought against a mathematician, but was also unusual in its enactment. Lorentz explains that in the Soviet Union there were two types of trial, those conducted internally by the secret state police, and show trials designed to publically shame and make examples of "enemies of the people" (Lorentz, 2002, p.204). In the case of Luzin, the media behaviour was that of a show trial, but the proceedings were secret. Furthermore, the secret police were not involved and the charges were not brought in terms of 'criminal code'. Given the extremely serious nature of his charges and lenient punishment, this appears to corroborate the idea that Luzin was being made an 'example' of.

Although not conclusive, one possible reason for this may have been to pressure mathematicians into publishing their best work within the soviet union. As Lorentz notes, the Stalin era led to increasing nationalism and isolationism in mathematics, and the state was keen to 'encourage' mathematicians to publish both in Russian and in Russian journals (Lorentz, 2002, p.218). This encouragement was not something that ambitious young mathematicians seeking international fame responded to willingly, and publishing his best work abroad was one of the many accusations brought against Luzin. Lorentz also hints at another possible reason that Luzin was made an example of, stating that during the Stalin era the communist party was usually unable to find leaders in the exact science that they could trust from within

their own ranks (Lorentz, 2002, p.219). Therefore, they had to be sure that leading mathematicians could be trusted to maintain the party goals. It is possible that the Luzin case served as a warning to younger mathematicians that, although permitted a level of autonomy, they were ultimately at the mercy of the state.

In conclusion, it is clear that mathematics was subject to intense philosophical criticism during the Stalin era. This is clearly evidenced through the writings, publications and historical reports of Marxist theoreticians and state inquisitors such as Kolman and Yanovskaya. The very foundations and theories of mathematics were seen as cause for suspicion. Furthermore, these were certainly not idle threats, as political persecution and purges during the Stalin era are well documented. Likewise, the Luzin case shows that mathematicians were not entirely immune to this persecution. However, the success of soviet mathematicians during this time, and the fact that they continued to study and contribute to otherwise 'forbidden' subjects, shows that the relationship between mathematicians and the state was much more complex. Through a combination of political pandering, application of theory to the goals of communism, and an economically privileged position, many soviet mathematicians were able to succeed and operate with relative autonomy. Although not conclusive, this hints at motivations beyond simply brute application of Marxist and Stalinist policy, and toward a more nuanced understanding of the relationship between mathematics, science and the Soviet Union.

Word count: 3492

References

Annellis, I.H (1987). Sof'ja Aleksandrovna Janovskaja (1896-1966). *In*: Grinstein, L, (ed). *Women of Mathematics*, Westport, Conn: Greenwood Press, pp.80-85.

Bailes, K.E (1986). Soviet Science in the Stalin Period: The Case of V. I. Vernadskii and His Scientific School, 1928-1945. *Slavic Review*. **45**, pp.20-37.

Bashmakova, I.G et al. (1966). SOF'YA ALEKSANDROVNA YANOVSKAYA (on the occasion of her seventieth birthday). *Russian Mathematical Surveys*. **21(3)**, pp.213-216.

O'Connor, J. Robertson, E (1999). *Nikolai Nikolaevich Luzin* [online]. Available from: <http://www-history.mcs.st-andrews.ac.uk/Biographies/Luzin.html>. [Accessed 8th November 2017].

O'Connor, J. Robertson, E (2006). *Sof'ja Aleksandrovna Janovskaja* [online]. Available from: <http://www-history.mcs.st-andrews.ac.uk/Biographies/Janovskaja.html>. [Accessed 7th November 2017].

Encyclopaedia Britannica (2006). *Andrey Nikolayevich Kolmogorov* [online]. Available from: <https://www.britannica.com/biography/Andrey-Nikolayevich-Kolmogorov>. [Accessed 12th November 2017].

Encyclopaedia Britannica (2013). *Stalinism* [online]. Available from: <https://www.britannica.com/topic/Stalinism>. [Accessed 25th October 2017].

Encyclopaedia Britannica (2016). *Dialectical materialism* [online]. Available from: <https://www.britannica.com/topic/dialectical-materialism>. [Accessed 25th October 2017].

Encyclopaedia Britannica (2017). *Marxism* [online]. Available from: <https://www.britannica.com/topic/Marxism>. [Accessed 24th October 2017].

Encyclopaedia Britannica (2017^{B}). *Pavel Sergeevich Aleksandrov* [online]. Available from: <https://www.britannica.com/biography/Pavel-Sergeevich-Aleksandrov>. [Accessed 12th November 2017].

Figes, O. (2007). *The whisperers : private life in Stalin's Russia*. 1. ed. London: Allen Lane, pp.227-315

Graham, L.R (1993). *Science in Russia and the Soviet Union : a short history*. 1. ed. New York: Cambridge University Press, pp. 148-149

Kol'man, E. (1930). Politika, ekonomika i matematika. *Na bor'bu*, pp.53-54.

Kol'man, E. (1931). Vreditel'stvo v nauke: Bol'shevik, 2 , p.76

Kutateladze, S. S. (2007). THE TRAGEDY OF MATHEMATICS IN RUSSIA. *Siberian Electronic Mathematical Reports*. **9**, pp.1-14.

Lenin, V. (1964). Materialism and Empirio-criticism - Critical Comments on a Reactionary Philosophy. *In*: [V. I.] Lenin, Moscow: Progress Publishers, pp.218.

Levin, A.E (1990). Anatomy of a public campaign: "Academician Luzin`s case" in Soviet political history. *Slavic Review*. **49**, pp.90-108.

Lorentz, G. G. (2001). Who discovered analytic sets?. *The Mathematical Intelligencer*. **23**, pp.29-32.

Lorentz, G. G. (2002). Mathematics and Politics in the Soviet Union from 1928 to 1953. *Journal of Approximation Theory*. **116(2)**, pp. 169-223

Marx, K. (1983). *In* The Mathematical Manuscripts of Karl Marx . Trans. by Aronson, C.. London : New Park.

New York Times (1979). *Prof. Ernst Koffman, A Confidant of Lenin, Dies in Sweden at 85* [online]. Available from: <http://www.nytimes.com/1979/01/26/archives/prof-ernst-kolman-a-confidant-of-lenin-dies-in-sweden-at-85.html>. [Accessed 6th November 2017].

Parthasarathy, K. R (1988). Obituary: Andrei Nikolaevich Kolmogorov. *Applied Probability*. **25**, pp.445-450.

Pontriagin, L. (1934). The General Topological Theorem of Duality for Closed Sets. *Annals of Mathematics*. **35**, pp.904–914.

Trotsky, L. (1973). *Problems of everyday life : creating the foundations for a new society in revolutionary Russia*. 1st. ed. New York: Pathfinder, pp.101

Yakov, S. (2003). Pavel Sergeevich Aleksandrov. *In*: *Russian Mathematicians In The 20th Century.* Singapore: World Scientific

Yanovskaya, S. (1930). Ocherednye zadachi matematikov–marksistov
. *Pod znamenem marksizma*. **5**, pp.88-94.

Yanovskaya, S. (1933). O matematicheskikh rukopisiakh K. Marksa. *Pod znamenem marksizma*. **1**, pp.74–115.

Vucinich, A. (1999). Mathematics and Dialectics in the Soviet Union: The Pre-Stalin Period. *Historia Mathematica*. **26**, pp.107-124.

Vucinich, A. (2000). Soviet Mathematics and Dialectics in the Stalin Era. *Historia Mathematica*. **29**, pp.13-39.