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The Lysenko effect: undermining the autonomy of science

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The 'Lysenko affair', which lasted roughly from the mid-1930s to the mid-1960s, was the big scandal of 20th-century science: a classic example of how politics can corrupt and undermine its rational basis. Under Stalin's leadership the Soviet Government suppressed genuine genetics and other sound biology, with devastating consequences for agriculture and health. The worst example of this occurred in August 1948 when the Politburo outlawed the teaching of and research into classical Mendelian genetics. There is broad agreement that this case offers a stark warning against politicians interfering with science. But what, precisely, is this interference that we are being warned about? Whereas the fate of genetics in Soviet Russia was a clear-cut example of direct suppression, there were also other less obvious ways in which politics subverted the scientific process. This indirect interference with science is a persistent feature of modern politics that we need to be on the lookout for.

Introduction

Direct political intervention can change the course of science. There is no better illustration of this statement than the story of Lysenkoism – the suppression of *bona fide* genetic research in Soviet Russia during the middle of the 20th century. There are, however, indirect and more subtle ways in which politics can interfere with the scientific process, and their interaction is also important because a long-term science policy that uses them prepares the ground for direct interventions.

The historiography of Lysenkoism has focused on the later period of Trofim Denisovich Lysenko's colourful scientific career. This is a tale of bad science, administrative wrongdoings and a political fight to get rid of Lysenko. The standard account of the Lysenko affair depicts a political scandal with little or no real scientific substance: it was a case of good scientists being simply overrun by dictatorial and ill-educated politicians [1]. The tyrant Stalin teamed up with the pseudo-scientist Lysenko and ousted genuine scientists like Nikolai Vavilov.

In *The Lysenko Affair,* David Joravsky maintains that neither Marxist theory nor Lamarckian ideas about heredity were important causes of the Lysenko phenomenon [2], a view that another leading historian of Soviet science, Loren Graham, agrees with. It was, Graham suggests, 'a chapter in the history of pseudoscience rather than the history of science' [3].

It is true that Lysenko ended up rejecting sound science. But what was it that took him and so much of Soviet biology into the sphere of 'pseudoscience'? The role of science policy is invisible to the Cold War perspective of Joravsky and Graham, but a more adequate approach was demonstrated by left-wing critics of establishment science in the 1970s. Richard Lewontin and Richard Levins saw Lysenkoism as 'an attempt at scientific revolution', a genuine attempt to make science better able to improve society and its ideals [4]. Instinctively, it seems correct that science should be subordinate to human values and used to increase human wellbeing, but there was something disastrously wrong about the way the idea was implemented in the case of Lysenkoism.

It is now time to look more closely at the conditions in Soviet science prior to World War II and the science policy of the Soviet administration that enabled Lysenko to reach the position he did. In the early years of Lysenko's career, when he was a plant physiologist rather than a geneticist, he enjoyed extensive support and sympathy from established scientists. However, although Lysenko's later ideas drew considerable criticism – he moved from working in plant physiology into breeding and genetics in the first half of the 1930s – science policy in Soviet Russia during these years managed to promote Lysenkoism without direct and objectionable political intervention. Today, the Soviet political system of the Stalinist era is distant history and it is possible to see Lysenkoism as the symptom of a fundamental dilemma in the ideology and politics of modern science that remains unresolved to this day. What is the purpose of science? Is it to achieve pure understanding or utilitarian outcomes? And if both are important, what is the relationship between them?

Political and ideological background

The background to Lysenko's meteoric rise in Soviet biology was the grand policy of state-supported science and technology introduced with the first five-year plan, which was intended to run from 1928–1932. Soviet Russia was the first country in the world to introduce a purposeful and generously funded state policy for scientific and technological development, and this lead to such milestones as the thermonuclear bomb, the first satellite to orbit the Earth and the first manned flight in space. But although Soviet Russia possessed more scientists than any other country in the world up until

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the 1970s, this enormous resource of manpower and investment proved inefficient in basic science as well as in technological innovation.

The chief cause of Lysenkoism lay in the vast empire of research set up to modernize Soviet agriculture. The Lenin Academy of Agricultural Science was established in 1929 as the great modernization of Soviet Russia began with forced industrialization and the collectivization of agriculture. The first president of the Lenin Academy, Nikolai Vavilov, described the institution as 'the academy of the general staff of the agricultural revolution', the 'general staff" being the Ministry of Agriculture. As president, Vavilov emerged as the leading entrepreneur of a research programme that promised unprecedented growth in agricultural production.

At the 1931 International Congress for the History of Science in London, Nikolai Bukharin, the most scholarly and intellectual member of the Soviet leadership, gave the keynote speech on 'Theory and practice from the standpoint of dialectical materialism'. He explained how a revolutionary unification of theory and practice was taking place in Soviet science. This, he argued, would eliminate 'the rupture between intellectual and physical labour'.

> The unification of theory and practice, of science and labour, is *the entry of the masses* into the arena of cultural work, and the transformation of the proletariat from an object of culture into its subject, organizer and creator. This revolution in the very foundations of cultural existence is accompanied necessarily by a revolution in the *methods* of science…

Bukharin used agricultural science as his prime example and the young left-wing Western scientists received his message with enthusiasm [5].

Vavilov and Lysenko

Vavilov and Lysenko were the two key figures in the rise of Lysenkoism. Vavilov was the son of a rich self-made merchant. He received a thorough modern education, trained at the agricultural academy and got picked for a career in research that led to him being sent abroad to further his studies in botany, plant pathology and plant breeding. Although his father fled Russia during the revolution of 1917, Vavilov and his brother, the physicist Sergei Vavilov, stayed to become citizens of Soviet society and prominent leaders in the Soviet scientific establishment. Lysenko was the son of an Ukranian peasant. He did not learn to read and write until he was 13 [6], and never learnt a foreign language. But he was bright and diligent: in 1918 he went to a prestigious school of gardening; in 1922 he was appointed a senior specialist at an agricultural research station; and in 1925 he graduated from the Kiev Agricultural Institute as an agronomist.

Vavilov, the progressive bourgeois scientist, and Lysenko, the peasant made good, therefore represented the two main types of scientific experts in early Soviet Russia. However, it is worth noting that neither man became a member of the Communist Party. They were both dedicated specialists and did not engage in ideological debates and general politics.

Vavilov's broad international contacts and his criticism of how the Soviet government handled agricultural science were seen as signs of disloyalty. In 1940, he was arrested and charged with spying for the British. Vavilov was sentenced to death, but this was commuted to life imprisonment and he died under miserable conditions in a prison near Saratov in 1943. During his last years he fought heroically against the suppression of genetic science, and in posterity he stands not only as the martyr of genetics but also as a symbol of free and genuine science in Stalinist Russia.

Nevertheless, Vavilov was also the patron who helped push Lysenko up through the Soviet scientific hierarchy [7]. In the early 1930s, he successfully proposed the young scientist for membership of the Ukrainian Academy of Sciences. He even supported Lysenko's projects in the face of growing criticism up until the mid-1930s: at a meeting of the Lenin Academy in the summer of 1935, Vavilov passionately defended Lysenko against criticism of his ideas about seed production and plant breeding. Of course Lysenko's understanding of genetics was weak, he admitted, but his work on vernalization was of great importance. [8]. As late as 1937, Vavilov failed to support the grand old man of Russian experimental biology, Nikolai Koltsoff, when he tried to spearhead a public confrontation with Lysenkoism [9]. It was not until 1938, when Lysenko became the president of the Lenin Academy, and had thus taken Vavilov's position as the leading administrator in Soviet agricultural science, that Vavilov spoke out strongly and clearly against him.

Vernalization

One reason that standard historical accounts have failed to recognize that any real, serious scientific issues were present in the controversy over Lysenkoism is that they have ignored Lysenko's contributions to plant physiology. Although it was highly uneven, burdened by poor methodology and overrated by his supporters, Lysenko's early work in this area did have some scientific substance.

'Vernalization' is still a current scientific term in plant development for the effect that periods of low temperature have on the time of flowering. This term entered scientific literature in 1933 as a direct translation (latinization) of Lysenko's Russian term 'iarovizatsiia' [10]. Western textbooks on plant physiology included Lysenko's work as a standard reference on this topic right up to the 1970s.

Lysenko's only large research publication was *Effects of the Thermal Factor on the Duration of Phases in the Development of Plants*, which was published in 1928 by the central experimental and breeding station of Azerbaijan. He built on the work of Gavril Zaitsev – the head of Soviet research on cotton, who was based in Tashkent and was a friend of Vavilov's. Lysenko's aim was to create a general formula that could predict the effect temperature would have on plant development. If such a formula could truly represent the laws of nature then it would be extremely useful for agriculture, argued Lysenko, especially in a country with such diverse climates as Russia.

In 1927 Vavilov wanted to give Lysenko a laboratory at the All-Union Institute for Plant Industry, where he was director. But the head of plant physiology there, Nikolai Maksimov, objected. He found Lysenko not only uneducated, but also stubborn and unreceptive to criticism and argument. He did not share Vavilov's belief that the young enthusiast could be steered into a productive scientific career.

In January 1929, Vavilov recommended that Lysenko speak at a big national conference on plant and animal science. At the conference Maksimov acted as a friendly critic, recognizing certain experimental achievements but finding little merit in Lysenko's theoretical ideas. But this did not satisfy Lysenko's scientific ambitions. To prove his theory he staged a public demonstration: the perishing of winter grain due to lack of snow cover in winter was a perennial problem and Lysenko claimed to have solved it by sowing ordinary winter grain in the spring, after it had been slightly germinated and then kept at a temperature just above freezing for a fortnight. In the summer, the press reported Lysenko's experiment had produced an exceptionally lush and productive crop of grain. But the method was not new. It has been tried in both Europe and North America and found to not be economically viable. However, the possibility of refining existing methods of crop production could not be denied, and by the end of 1929 Lysenko was in charge of a large research project at the All-Union Institute for Genetics and Plant Breeding at Odessa.

The treatment of winter grain soon proved impractical. Instead Lysenko launched the vernalization of spring grain. This was a much less spectacular proposal as spring grain was what one would sow in the spring anyway. But Lysenko claimed that such treatment would speed up development and result in earlier ripening, thus counteracting the effects of the summer drought. This method was subsequently applied on a large scale without prior testing. Lysenko sent questionnaires to farms that had used the method and claimed an increase in yield of around 10% on average. This subjective 'test' was blatantly inadequate and was dropped quietly after some years. But Lysenko's public reputation remained. He had become the model for a new Soviet scientist – one who effectively integrated science and production, or 'theory and practice'.

From plant breeding to genetics

At the start of his career Lysenko dabbled in plant breeding. He even published a simple technical paper on tomato breeding in a conference report [11]. As his early success in physiology lost momentum he was tempted to expand his physiological theory of the development of plants into a more comprehensive theory including plant breeding and genetics. Vavilov enthusiastically backed Lysenko's involvement in plant breeding, not for its genetic ideas, but for its instrumental usefulness to Vavilov's own main project.

Vavilov's great project was the World Collection, the first large-scale gene bank of cultivated plants. It was established and maintained at great expense, but Vavilov promised it would quickly repay this cost many times over by producing new superior varieties. However, the Soviet regime felt that time was short in its struggle with capitalism and fascism, and that the timeframe Vavilov predicted for progress was thus not quick enough. In 1931 a government decree made the completely unrealistic demand that new varieties should be produced in 4–5 years instead of the 10–12 years that had been agreed when the project began. A crucial problem for Vavilov was to make the diverse varieties, collected from all over the World, flower under Russian climatic conditions. It was necessary to get the samples to flower both to test their properties and to produce the necessary hybridization.

Lysenko's ability to control development in plants impressed Vavilov and they struck up an extensive cooperation. At the International Congress of Genetics in August 1932,Vavilov praised Lysenko's 'remarkable discoveries' and the 'enormous new possibilities' they opened to plant breeding and genetics [12]. Thus the vernalization of Vavilov's World Collection became Lysenko's route into genetics.

Scientific method in theory and practice

Although Lysenko's work on vernalization attracted interest and appreciation, both at home and in the international scientific community, there was strong criticism when he and his collaborators began to think about genetics. The physiology of plant development was a new and undeveloped field of science when Lysenko started his work in the 1920s, whereas plant breeding was a well-established branch of applied biology by the 1930s that was linked to a developed theory of classical genetics. However, some basic ideas of heredity were still hotly debated. Whether hereditary factors – the genes – really existed as particulate (molecular) structures was still not clear. And neo-Lamarckism – the view that heritable characteristics were shaped directly by adaptation to the environment – still appeared plausible to many biologists. For example, Vladimir Komarov, a botanical ecologist and president of the Soviet Academy of Sciences from 1936–1945, was a supporter of neo-Lamarckism.

Thus Lysenko's neo-Lamarckian views were not out of the bounds of genuine science. The German–American geneticist Richard Goldschmidt favoured a 'theory of the germ plasm in which the individual genes as separate units will no longer exist' [13]; and the Soviet geneticist Anton Zhebrak, who became one of the staunchest defenders of classical genetics against Lysenkoism by the end of the 1930s, made extensive efforts to find mechanisms that would transform enduring modifications into true hereditary factors (i.e. engineering the inheritance of acquired characteristics) [14]. When Western scientists of Marxist inclination, like Joseph Needham, John Desmond Bernal and J.B.S. Haldane defended Lysenko in the late 1930s and the 1940s, they emphasized the importance of research such as this on possible ways to affect the heredity of plants and animals.

Lysenko's scientific weakness was most evident in a deficient understanding of methods of experimentation and testing. It is notable that precision is often more essential in the evaluation of practical applications than

in theoretical development. Inaccurate experiments or observations are often sufficient to enable the discovery of a new causal mechanism or entity to be put forward for scrutiny, but the demonstration of economic usefulness for new agricultural methods generally depends on the precise and sophisticated use of statistics. Therefore, whatever contributions Lysenko made to plant physiology were in theory rather than in application – quite opposite to the reputation he had with the Soviet public.

Vavilov's scientific strength was in basic research, as a botanist. He was primarily a theoretician and administrator. In plant breeding and other applied agricultural science he was more a provider of enthusiastic leadership than critical scientific evaluation [15]. To Vavilov, Lysenko was an erratic enthusiast who had made some highly valuable contributions and might stumble on more, despite his uncritical methods and wild ideas about genetics. A prominent British plant breeder conducted a long interview with Lysenko in 1933 and was appalled by his ignorance. But Vavilov soothed him: angry young men like Lysenko who 'walked by faith more than light' have been essential to the progress of world science, he argued. To let him go on working could do no harm. 'He might even discover how to grow bananas in Moscow,' said Vavilov [16].

As long as the scientific establishment in Russia had sufficient autonomy to ensure Lysenko's wild claims underwent an effective critical analysis, Vavilov was probably right to hold this liberal attitude. However, in the middle- and late-1930s he and his colleagues increasingly had to insist that the controversies surrounding Lysenko's ideas should be solved through experimental scientific investigations and tests. But the Stalinist purges of 1936–1938 removed top science officials who were skeptical of Lysenko and further restricted the room for public criticism in politically sensitive areas of science. And when Lysenko became president of the Lenin Academy in 1938 it was too late. In this position he could effectively suppress attempts at serious public tests of his claims.

Conclusion

There are two reasons why the early period of Lysenkoism – up to 1938 – is of great interest. First, the scientific issues of this period have been largely overlooked by historians of science, particularly with regards to the scientific content and context of Lysenko's work. Second, this period has considerable relevance to present problems in the politics of science. Today we are more under threat from the indirect effects of science policy on the trustworthiness of science than we are from the blatant direct political suppression that loomed so large in the Cold War period. Science policy guided by Marxist theory and developed by the scientific community itself promoted the rise of Lysenko in cooperation with the Soviet Government.

Comparing the effects that different anti-liberal political ideologies, like those of the French and Russian revolutions, as well as the Nazi regime in Germany, have had on science has been a hot scholarly topic. The philosopher Karl Popper saw a deep conflict between such outlooks and the enlightenment ideals of the scientific tradition, and believed that this was closely linked to the extremist undermining of liberal democracy [17]. The sociologist Robert Merton similarly extracted from the scientific tradition an 'ethos of science': a set of ideals and values that he saw as constituent of the scientific tradition that had been severely violated both by Nazis and by Soviet communists [18]. For Popper and Merton, it was the defence of autonomy for science that mattered, technology was subordinate to economic and political control, and rightly so.

This idea of mutual support and dependence between science and liberal democracy has been criticized and rejected by historians of science [19]. In the 1950s the American historian of science Charles C. Gillespie compared Soviet ideas about science, like those presented by Bukharin in London in 1931, with the romantic, moralizing and voluntaristic Jacobin philosophy of science [20]. Gillespie pointed to examples where the French revolution had dramatic consequences on science, such as the dismantling of the French Academy of Science. But he rejected a corresponding explanation that Lysenkoism was a product of political ideals being imposed on science: owing to its 'character of impersonality' modern 20th-century science was immune to such ideological influence. The Lysenko controversy did not matter to science but only to scientists, argued Gillespie [21]. Unlike Popper and Merton he did not distinguish between the social roles of science and technology, but agreed with Jacobins and Marxists that the effect of science on society is through 'the fruits of technology' [22]. The preceding account shows how legitimate choices were perverted by the lack of a sense of the difference between basic and applied science. The indirect suppression of science through a misguided science policy was an essential aspect of the biggest scandal in the 20th-century politics of science. In this sense we should talk about the 'Lysenko Effect' rather than the 'Lysenko Affair'.

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