

# Mendel, Darwin, and Lysenko: the battle toward understanding genetics

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**August 1948 saw the Soviet government ban all teaching and research in genetics. Within a year, “the doctrine of agronomist Trofim Lysenko – dubbed ‘Soviet Creative Darwinism’ – replaced genetics in curricula and research plans of biological, medical, veterinary, and agricultural institutions.” (Krementsov 2010)**

This year, 2022, on the occasion of Gregor Mendel’s 200th birthday, I want to commemorate his great achievements as a pioneer of genetics as well as the strongest attack on the gene concept in the history of science, launched in the Soviet Union under Stalin.

The Augustinian monk Gregor Mendel conducted his research on the hybridization of plants in the 1850s and 60s at his monastery in Brünn (today Brno). His “law governing the formation and development of hybrids” (1865) was the most prominent example of a mathematical model in biology and has remained crucially important until the present day. It was based on years of research on hybridization in pea plants, in which Mendel reduced the complex features of hybridization to the behaviour of hypothetical elements of heredity in a quantitative way.

For Mendel, mathematics was of fundamental importance for understanding life processes. His use of statistics and the concept of probability helped him find regularities and propose laws despite widespread chance events, as he wrote (1865): “It remains, therefore, purely a matter of chance which of the two sorts of pollen will become united with each separate egg cell. According, however, to the law of probability, it will always happen, on the average of many cases, that each pollen form A and a will unite equally often with each egg cell form A, and a” (emphasis added).

Unlike other models, Mendel’s was not only descriptive but causal and explanatory. It later gave rise to the concept of the gene, one of the most powerful abstractions in biology.

## Darwin’s concepts of variation and heredity

Darwin is most famous for his “On the Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life” (1859), in which he proposed a materialistic theory of evolution, in his words, “descent with modification.” Darwin’s theory complemented older evolutionary theories, for example, that of Lamarck, with natural selection. In 1868, Darwin also proposed a (flawed) theory of heredity that he called “Pangenesis.”

For various reasons, Darwin tried to exclude the role of chance in his theories and finally explained the heritable variations on which natural selection was based by the heritable effects of environmental conditions and the use and disuse of organs, similar to Lamarck. These ideas played a major role in his “Hypothesis of Pangenesis,” in which Darwin aimed at setting up a unifying explanation for phenomena of heredity, variation and development. Pangenesis is the idea that all parts of the body, including those that have changed throughout life, “throw off minute granules or atoms, which circulate freely throughout the system.” They constitute sexual elements and are ultimately developed into units like those from which they were originally derived (Darwin 1868). Darwin thus established the theoretical foundation for a mechanistic explanation for the inheritance of acquired characteristics; see Deichmann (2010) and references therein.

## **Trofim Lysenko’s destruction of genetics in the USSR**

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Lysenko (1898-1976) was an agronomist from Ukraine who rose to power in the 1930s. Through a technique called “jarowisation” (“vernalization”), he purported to have induced winter-wheat seeds to produce a crop also in spring. His later claims that the vernalization effects were heritable and plants could be “re-educated” marked the beginning of his fight against established genetics.

The ideological background for his anti-genetic doctrine was the high popularity of Darwin’s materialistic ideas among the liberal and revolutionary intelligentsia in Russia and the fact that Mendelism was regarded as opposing Darwinism and a materialistic viewpoint. While population genetics for some years flourished, massive campaigns to popularize both Marxism and Darwinism since the 1920s also excoriated Mendel’s views. The devastating situation in Soviet agriculture after the large-scale collectivization of private farms led to Lysenko’s support in the hope that his methods would improve agriculture, an unfulfilled hope.

Lysenko did not follow any scientific theory, and his way of working was non-methodical, for example, using extremely small and genetically heterogeneous samples and lacking controls ( Joravsky 1970). He derived his ideas from practical agriculture and popular beliefs. He rejected the distinction between genotype and phenotype (equated with “Mendelism, Morganism, and Weismannism”) because materialistic biology had to be holistic: “It does not separate heredity from the living body and the conditions of life; [heredity is] inherent not only in the chromosomes but in any particle of the living body.” This is reminiscent of Darwin’s “Pangenesis” but was asserted 80 years later, disregarding all advances in genetics and cell biology. Lysenko considered mathematics and the “statistical formulas of the Mendelists” useless and rejected the idea of randomness in nature and science (all citations from Lysenko 1948).

His role model was Ivan V. Michurin (1855-1935), a popular agricultural practitioner and breeder of fruit trees, who was celebrated as the founder of Soviet creative Darwinism.” Lysenko’s pseudoscientific “Michurinism” received its influence entirely through political terror. Geneticists were suppressed, and an unknown number of them were murdered,

among them the renowned geneticist and botanist Nikolai I. Vavilov. Only after Khrushchev was removed from power in 1964 did Lysenko finally lose government support.

## **The recent rebirth of Lysenkoism in Russia**

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After the collapse of the Soviet Union, trends to reassess or even rehabilitate Lysenko's pseudo-scientific ideas started affecting science in Russia, supported by "Putin's revival of Soviet attitudes" (Graham 2015). The claim that Lysenko's 1930s views are confirmed by modern-day epigenetics turned out not to be tenable. According to Kolchinsky et al. (2017), this neo-Lysenkoist trend is "largely based on political arguments," in which the science of genetics is accused "of serving the interests of American imperialism and acting against the interests of Russia."

Lysenkoism in the past and neo-Lysenkoism today have been the strongest attack on the concept of gene and genetic causality with devastating effects on science and agriculture in the countries concerned. Otherwise, Mendelian concepts and methods laid the foundation for quantitative genetics, led to the development of new experimental methods, and Mendelian genetics has led to new precise breeding techniques in all parts of the world.

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