

# Epigenetics and Russia<sup>1</sup>

LOREN GRAHAM

Professor of History of Science, Emeritus  
Massachusetts Institute of Technology and Harvard University

Epigenetics is a controversial but nonetheless booming field in biology worldwide. At the moment, the term is a buzzword that not only is featured in many scientific journals but is also being celebrated widely and often inaccurately in popular media. Several years ago, the German magazine *Der Spiegel* featured epigenetics on its cover with the exaggerated announcement “Victory over Genes.”<sup>2</sup>

According to epigenetics, environmental influences, such as nutrition and stress, can cause changes in inheritance in organisms, and this changed inheritance can last several generations, maybe more. Such epigenetic changes are not based on alterations of the underlying DNA but instead on genes that are marked in such a way, often by methyl groups, that they are turned “on” or “off.” In other words, the genes are either expressed or not expressed in further development.

One of the reasons why epigenetics is controversial is that it postulates that these genes are thus marked by experiences during the lives of individual organisms; therefore, it seems to revive the doctrine of the “inheritance of acquired characteristics,” a view often called “Lamarckism.” Lamarckism was seen as thoroughly discredited by most biologists in the twentieth century but now has some new supporters.

A particularly infamous exponent of the inheritance of acquired characteristics in the twentieth century was Trofim Lysenko, the agronomist who ruled Soviet biology for several decades. With Stalin’s support, he purged the field of his critics. Many well-known Russian biologists were fired, imprisoned, and sometimes even executed. In the West, “Lysenkoism” became synonymous with “pseudo-science.”<sup>3</sup> It was a prime example of the ruinous effects of political rule over science.

In recent years, to the absolute amazement of those few Western observers who have noticed, a rebirth of Lysenkoism has occurred in

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1 Read 14 November 2015. The current essay is based on the author’s book *Lysenko’s Ghost: Epigenetics and Russia* (Cambridge: Harvard University Press, 2016)

2 “Der Sieg über die Gene,” *Der Spiegel* 32 (2010), cover page.

3 Michael Gordin, “How Lysenkoism Became Pseudoscience: Dobzhansky to Velikovsky,” *Journal of the History of Biology* 45, no. 3 (2012): 443–68.

Russia. Dozens of articles and books have appeared praising Lysenko and claiming that his views are confirmed by epigenetics. These publications have such titles as “The Truth of Trofim Denisovich Lysenko is Confirmed by Modern Biology,”<sup>4</sup> and “A Sensation: Academician Lysenko Turned Out to Be Right.”<sup>5</sup> As a result of this resurgence of praise for Lysenko, a great debate has been going on in Russia in recent years about Lysenko and epigenetics.

Most of the publications reviving Lysenko in Russia were written by old-line Stalinists, people who simultaneously praised the agronomist and Stalin who supported him. But defenses of Lysenko became much more serious in 2014 and 2015. In 2014, P. F. Kononkov, an old supporter of Lysenko, published a book titled *Two Worlds—Two Ideologies* which continued his old arguments but was presented under new ominous auspices: the book was subsidized by a government organization, the Federal Agency on the Press and Mass Communication.<sup>6</sup> The Russian historian Eduard Kolchinsky saw this subsidy as “the tolling of the bell,” alerting Russian biologists to the specter of government support for Lysenko, once again, decades after an earlier similar episode.<sup>7</sup>

Also in 2014 and 2015, two established biologists—Lev Zhivotovskii and A. I. Shatalkin—published books in which they described Lysenko as a significant scientist unappreciated in the West.<sup>8</sup> Zhivotovskii is a well-known scientist with a doctorate in biological science, a specialist in population genetics, and a researcher at the Institute of General Genetics of the Russian Academy of Sciences. He has published widely in international peer-reviewed journals on the topic of early human migration and has worked closely with foreign biologists, especially at Stanford University. Shatalkin is an entomologist who has published widely in his field. He has long had an interest in Lamarck and the inheritance of acquired characteristics.

Upon close examination of their works, it can be seen that Zhivotovskii and Shatalkin have given shallow defenses of Lysenko, as described in my book on the subject.<sup>9</sup> Nonetheless, the entry into the rolls of contemporary defenders of Lysenko in Russia of such qualified scientists as Zhivotovskii and Shatalkin demonstrates that this

4 Maksim Kalashnikov, accessed at <http://m-kalashnikov.livejournal.com/1510946.html>

5 Accessed at <http://contrtv.ru>

6 P. F. Kononkov, *Dva mira – dve ideologii. O polozhenii v biologicheskikh i sel'skokhoziaisvennykh naukakh v rossii v sovetskii i postsovetskii period* (Moscow: Luch, 2014).

7 Eduard Kolchinsky, e-mail to the author (and others), 21 November 2015.

8 Lev Zhivotovskii, *Neizvestnyi Lysenko* (Moscow: T-vo nauchnykh izdaniy KMK, 2014). A. I. Shatalkin, *Reliatsionnye kontsepsii nasledstvennosti i bor'ba vokrug nikh v XX stoletii* (Moscow: T-vo nauchnykh izdaniy KMK, 2015).

9 Loren Graham, op. cit., pp. 119–22.

phenomenon is serious and will not go away soon. Many established Russian geneticists feel concern; some now fear any research linked to Lysenko, especially in the new science of epigenetics.

#### SURPRISING EFFECTS OF THE NEW LYSENKOISM

Established Russian geneticists, who know that Lysenko was a poor scientist, have been somewhat unwilling to explore transgenerational epigenetics because of their concern about the attempted rehabilitation of Lysenkoism. Given their experiences and history, they are a little frightened of epigenetics. As M. D. Golubovsky, a Russian biologist and historian of biology (now in the United States) wrote: “When a serious scholar found something that apparently conformed to Lysenko’s views, he was afraid to make his discovery public, being scared of being ostracized by the academic community.”<sup>10</sup> Epigenetics has also shaped a new and surprising attempt to connect Lysenko’s views with Orthodox religion.

#### AVOIDING DISCUSSION OF TRANSGENERATIONAL EPIGENETIC INHERITANCE

Some of the best university textbooks on genetics in Russia, written by fully qualified scientists who are critical of the recent upsurge in Lysenkoism, avoid extended discussions of transgenerational epigenetic inheritance. They fear saying anything that might be used by Lysenko’s supporters. An example is Serge Inge-Vechtomov’s *Genetics and the Foundations of Selection*.<sup>11</sup> Inge-Vechtomov is an excellent scientist, a man who helped reconstruct genetics in Russia after Lysenko’s demise, and in his textbook for university students, he fully discusses the latest work in his field, including how epigenetic methylation of DNA and the modification of “histones” (i.e., proteins that organize DNA strands and provide structural support) can affect gene expression. Nonetheless, a careful reader will notice that his discussion of epigenetics concentrates on these effects within one generation, not on transgenerational transmission of characteristics. The book does not deny such transmission but simply omits any large discussion of it. I suspect that the reason for this is Inge-Vechtomov’s aversion to anything that could be called “the inheritance of acquired characteristics.” And knowing his history, I can fully understand.

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10 M. D. Golubovsky, “Nekanonicheskie nasledstvennye izmeneniia,” *Priroda* 9 (2011): 9.

11 Serge Inge-Vechtomov, *Genetika s osnovami seleksii: Uchebnik dlia studentov vysshikh uchebnykh zavedenii* (St. Petersburg: St. Petersburg University, 2010).

## FAMINE STUDIES

Many studies of epigenetics in the West have emphasized “famine studies” showing that the effects of famines can be discerned in descendants several generations after the famines themselves. Prominent examples have been the Dutch famine of 1944 in the German-occupied Netherlands and early nineteenth-century famines in small villages in Northern Sweden. Both the “Dutch Famine Cohort Studies” and the “Swedish Village Food Studies” describe how the descendants of survivors of famine, even generations later when everyone had adequate nutrition, suffer from lasting health defects, such as elevated rates of diabetes, coronary disease, breast cancer, and other ailments.<sup>12</sup>

As for famines in recent history that might reveal information about epigenetics, the example of Leningrad in the period from 1941 to 1945 quickly comes to mind. As horrible as the periodic village famines in Sweden in the nineteenth century and the Dutch famine of 1944–45 were, the Leningrad famine surpasses them immeasurably in terms of intensity and length. Only several hundreds of people died in the regions of Sweden subject to study, and an estimated 22,000 died in the Dutch famine of 1944–45. Incredibly, the famine deaths in Leningrad in 1941–45 approached one million (the figures are disputed and range from 670,000 to 1.2 million). In Leningrad, people ate all the birds, rats, and pets in the city and then, in some cases, resorted to cannibalism. Many bodies taken to cemeteries were missing parts.

What were the lasting health effects of the Leningrad famine? Although Russian biologists made studies of the health of the immediate survivors, I can find no studies that discuss the transgenerational effects of this famine, which is striking given the importance of other famines in the epigenetic literature. V. S. Baranov, an expert on the health effects of the Leningrad famine who as a small child lived through that event, told me on 10 January 2014 that “[u]nfortunately to my knowledge so far nobody looked for remote transgenerational (epigenetic) effects of this devastating hunger. No one wanted to work on this because it might affirm Lamarckism and Lysenkoism.”<sup>13</sup>

This omission illustrates the reluctance of established geneticists in

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12 See Tessa Roseboom, Susanne de Rooij, and Rebecca Painter, “The Dutch Famine and Its Long-Term Consequences for Adult Health,” *Early Human Development* 82 (2006): 485–91; David Epstein, “How an 1836 Famine Altered the Genes of Children Born Decades Later,” accessed at <http://io9.com/how-an-1836famine-altered-the-genes-of-children-born-d-1200001177>; Lars Olov Bygren, Gunnar Kaati, and Sören Edvinsson, “Longevity Determined by Paternal Ancestors’ Nutrition during Their Slow Growth Period,” *Acta Biotheoretica* 49 (2001): 53–9.

13 V. S. Baranov, Head, Laboratory, Academy of Medical Sciences, St. Petersburg, Russia, author interview, 20 June 2014.

Russia to look at anything that might revive the concept of the inheritance of acquired characteristics. Just as famine leaves its scars on survivors, so also does the suppression of a science leave scars on scientific survivors.

#### LYSENKO AND RELIGION IN CONTEMPORARY RUSSIA

One of the most surprising aspects of the current resurgence of support for Lysenko in Russia is the effort by some of his defenders to convert him into an advocate of religious orthodoxy and traditional Russian values. N. V. Ovchinnikov has completely reversed a common interpretation of Lysenko.<sup>14</sup> Instead of seeing him as Marxist, Ovchinnikov described him as a scientist whose views drew on deep Russian religious traditions. Ovchinnikov counterposed those traditions to the attitudes of Western pioneers of modern genetics such as Thomas Hunt Morgan, J. B. S. Haldane, and H. J. Muller, whom he descried as “atheists” who believed genetics was a part of a blind, heartless, contingent nature. Furthermore, according to Ovchinnikov, Muller and Haldane were despicable “Marxists.” Ovchinnikov approvingly noted that C. H. Waddington, after talking to Lysenko, concluded that “his philosophy has a strong taste of Orthodox religious theology.”<sup>15</sup> Ovchinnikov agreed with P. F. Kononkov that Lysenko merely “cloaked” his views in Marxist phrases because that was “the requirement of the time.” Kononkov and Ovchinnikov believe that Lysenko was a defender of a religiously inspired natural order battling with adherents of “atheism” and “Marxism” such as Haldane and Muller.

Ovchinnikov’s and Kononkov’s interpretations are stunning examples of how Nationalist and Orthodox (Russian Orthodox) ideologies are reigning in Putin’s Russia. Therefore, prominent Russians of the past, such as Lysenko, should be both national heroes and loyal to Orthodox religious thought. The fact that Lysenko was Ukrainian, not Russian, and that he made many statements supporting Marxism are disregarded in their discourse.

#### WAS LYSENKO RIGHT AFTER ALL?

For the moment, let us disregard these clearly political and ideological arguments coming out of Russia, and ask: In the light of the new evidence for the inheritance of acquired characteristics based on epigenetics, was Lysenko right in at least some of his scientific views?

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14 N. V. Ovchinnikov, *Akademik Trofim Denisovich Lysenko* (Moscow: Luch, 2010).

15 N. V. Ovchinnikov, *Arkhiv RAN*, f. 1521, op. I, no. 281, 87.

My answer is the following: Where he was right, he was not original; where he was original, he was not right. He was right in his belief in the possibility of the inheritance of acquired characteristics, but so were many of his predecessors and contemporaries. He was original in his claims that he could change one species into another, but his claims have not been replicated, and we must conclude that he was wrong.

Lysenko was actually a very poor representative of the concept of the inheritance of acquired characteristics. Other scientists, both in Russia and elsewhere, did a far better job. Lysenko's experiments were careless and usually unverifiable. The inheritance of acquired characteristics was better defended, even during Lysenko's reign, by scientists such as the American Tracy Sonneborn, who demonstrated such inheritance in the protozoan group *Paramecium*.<sup>16</sup>

The fathers and mothers of epigenetics did not use Lysenko's results but developed their views on the basis of molecular biology. The concepts of gene expression and the methylation of DNA would have been impossible without intimate knowledge of molecular biology. Rather than denying the importance of the genome, epigeneticists state that classical genetics makes the environmental effects of gene expression possible. The environment regulates transcription factors that bind to regulatory elements on the DNA and activate or repress gene expression—but the nucleotide sequence determines the ability of the transcription factors to bind in the first place.<sup>17</sup>

Lysenko could not possibly agree with the description of epigenetics given in the previous paragraph. He disregarded the action of genes and in 1974, 2 years before his death, made the following statement:

I declare that we have never used and are not going to use any ideas and methods of molecular biology. I would like to advise all biologists, plant and animal breeders and students in the Soviet Union against adopting these methods . . . .<sup>18</sup>

This was a man who would throw biology back decades, if not centuries. Warren Weaver coined the term “molecular biology” in 1938; in 1974, when Lysenko made the above statement, it was blossoming all over the world. To give Lysenko credit for what the pioneers of epigenetics did through enormous labor, based on the latest developments in molecular biology, would be both inaccurate and unjust.

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<sup>16</sup> See the discussion in Jan Sapp, *Beyond the Gene: Cytoplasmic Inheritance and the Struggle for Authority in Genetics* (New York: Oxford University Press, 1987), 179.

<sup>17</sup> I am indebted to Michael Meaney for this insight.

<sup>18</sup> Lysenko to N. P. Dubinin, 25 September 1974, in Eduard Kolchinsky, “Current Attempts at Exonerating ‘Lysenkoism’ and Their Causes” (unpublished paper), 9.