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N I K O L A I I V A N O V I C H V A V I L O V

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In her excellent biography of Alexander von Humboldt, Andrea Wulf observed that he was the most famous scientist of his age, even better known than Napoleon Bonaparte, but that now he is largely forgotten. My subject is a man whose scientific contributions should rightfully place him in the pantheon along with Charles Darwin, but who has suffered the same fate. Today few people, including members of the scientific community, know his name or of his accomplishments. Also disturbing is that now we are more likely now to remember the name of his nemesis, the pseudoscientist Trofim Lysenko.

We often attach a word to a scientist's name to identify his or her discipline. She is a chemist; he is a plant ecologist. For the multifaceted N. I. Vavilov, it would be entirely appropriate to describe him as a botanist, plant geographer, agronomist, geneticist, explorer, plant collector, and administrator. In that sense, it might be said that he was another Alexander von Humboldt. Sadly, one other label, perhaps unique among 20th century scientists, must be added — he was a martyr.

Vavilov was the son of a prominent and wealthy textile merchant. His younger brother, Sergey Ivanovich, would become a leading Russian physicist and a future President of the Academy of Sciences of the U. S. S. R. His two sisters became a microbiologist and a physician. He and his common-law wife Yelena Barulina, a research scientist, have two sons, both of whom became physicists.

As a child he maintained a small herbarium in his home. He would go on to collect seeds, tubers, and fruits from cultivated plants around the world, more than any other person in history. Vavilov grew up at a time when crop failures and food rationing were common. He devoted his career to the improvement of cereal crops to sustain our global population. He would become the head of the All Union Inst. Applied Botanist, a sprawling structure of 400 research institutes with 20,000 employees. During his career, he assembled and administered the world's largest seed repositories of crop plants He held important positions, such as membership in the Soviet Central Executive Committee. He was the youngest full member of the Soviet Academy of Sciences.

He was legendary for his energy, sleeping only four or five hours each night. He often said, *"Time is short, and there is much to do. One must hurry."* He possessed a prodigious memory. He could recite long passages of Pushkin from memory. On top of everything else, he was a polyglot. He learned 15 languages; he spoke Russian, English, German, Latin, French, Spanish, Farsi, and Turkic.

Vavilov collected thousands of plants in 64 countries. He talked directly to farmers about their crops. I doubt that anyone else has ever had such detailed knowledge of the world's cereals and other crops over such a broad geographic range. He was the author of over 350 publications, several of them issued posthumously. His scientific reputation rests on several important contributions, among them on his "law of homologous series in the inheritance of variability," "study of immunity of plants from infectious disease" and "Vavilovian mimicry," the idea that some weeds have survived by resembling the crops that we care for.

He is best known for his identification of centers of origin of our crop plants. He expanded upon and made more concrete earlier work by Charles Darwin and especially that of A. P. de Candolle in his *Origin of Cultivated Plants*. He had a very serious reason for wanting to know these origins — to gather and preserve seeds, tubers, and other plant parts to preserve the genetic diversity that they contained. Those genes would be needed to save us from various disasters. He reasoned that these areas could be found by analyzing patterns of variation. The geographic region with the greatest genetic diversity in a particular crop was its center of origin. These were the sites where crops had enough time to evolve diversity. As he put it, *"The region of maximum variation, usually including a number of endemic forms and characteristics as well, can usually also be considered as the center of type formation."*

During his career, Vavilov recognized from two to 12 centers of origin. Here is the most commonly cited version, with eight centers: I • Chinese (the earliest and largest); II • Indian, IIa • Indo-Malayan; III • Central Asiatic, IV • Near Eastern; V • Mediterraean; VI • Abyssinian; VII • South American and Central America; VIII • South American; VIIIa • Chiloe. More recent studies have reduced the number of centers to three or expanded it to 13. They have also argued that these regions are not always regions of origin, but regions of diversity. One author noted that if present day crop diversity were the criterion, then barley had its origin in a particular county in Tennessee. I attempted to make that point with the students in one of my courses. Would not present day diversity clearly suggest that we humans had our origin in what is now New York City, San Francisco, or Los Angeles? Vavilov later accepted that diversity does not always mean place of origin.

The Soviet Union is the home of the world's oldest seed repository, founded in 1894, with the goal of preserving crop plant biodiversit. It is also one of the largest collections, due primarily to the efforts of Vavilov, beginning with his 1916

Iranian field collections and his concerns that the wild ancestors of our crop plants were being lost as we relied increasingly on fewer and fewer cultivars. The facility, now called the Vavilov Institute of Plant Industry, is housed in a former tsarist palace in St. Petersburg. During World War II, the building faced possible destruction during the Siege of Leningrad, as the city was called at the time. It was saved from German bombing because of its location near the Astoria Hotel. Hitler wanted that area preserved because he planned a huge celebration at the hotel when Russia was defeated. The threat came from the starving citizens of Leningrad who knew the facility housed hundreds of thousands of packets perfectly edible seeds and grains. In one of its rooms is a gallery of photographs of the 28 botanists and staffs who starved to death while protecting the collection. Such was their loyalty to Vavilov and his mission. In a related story, Hitler ordered teams of his commandos to raid a number of Soviet scientific stations to seize what he thought to be critical to his plan for world domination — their seed collections!

Today the Institute houses an estimated 325,250 collections stored in metal containers in large shelving units. Most are kept at room temperate, but some at much lower temperatures. There are other major seed collections, the most recent being the Svalbard Global Seed Vault, located deep inside a mountain on a remote island just south of the North Pole. It has been dubbed the "Doomsday Vault," the "Noah's Ark" and the "Fort Knox" of seeds. It can hold 4.5 million seed samples. In 2020, the Cherokee Nation add nine samples of their heirloom crops.

As Vavilov's fame grew around the world, he found himself the target of scientific and political opposition, especially from one of his staff members, an ambitious charlatan named Trofim D. Lysenko. He postulated that genes did not exist and that the field of genetics was just some silly notion of a Catholic monk (Mendel). He was an enthusiastic champion of the discredited concept of that traits acquired during the lifetime of a plant or animal would be transmitted to their offspring. His bizarre ideas of crop breeding included the belief that one species of plant could be transformed into another in a matter of months by a process he called "vernalization." He ranted against the "Mendelists-Morganists-Weissmanists."

Lysenko had a very powerful patron -- none other than Josef Stalin himself. Vavilov was summoned to the Kremlin for a late night meeting with Marshall Stalin, who ridiculed his scientific contributions and asked, "*Well citizen Vavilov, how long are you going to go on fooling with flowers and other nonsense? When will you start raising crop yields?"* He went on to declare that Vavilov's services were no longer needed. I should note that there is some doubt that this meeting ever occurred. Lysenko would later declare that Stalin was the greatest biologist in history His discredited beliefs became officially approved Soviet agricultural policy. What could go wrong? Only the destruction of Soviet agriculture, the dismissal and death of an unknown number of scientists, and the death of millions of his fellow citizens from famine.

In August 1940, Vavilov was arrested by the KGB while on a collecting trip in the Ukraine. He was accused of destroying Soviet agriculture and of being a British spy, of accepting the concepts of western scientists, and rejecting those of Soviet workers, specifically those of Lysenko. It was later revealed that Vavilov had been under investigation beginning in 1931 and his file had grown over the years to fill seven volumes. During an eleven month period, he was subjected to hundreds of interrogations that lasted almost two thousand hours. After this ordeal, Vavilov admitted that he was guilty of various charges, but not of espionage. After a five minute trial that did not include lawyers, he was sentenced to death by firing squad. He would declare later that, "*We shall go to the pyre. We shall burn, but we shall not retreat from our convictions*." His appeal to the Presidium of the Supreme Soviet of the USSR was rejected. From prison, Vavilov wrote to Lavrentiy Beria, the infamous head of state security, but to no avail. In late 1941, he was moved from a prison in Moscow to one in Saratov, the city where had once been a professor at its university. In reality, he was sent to one of the infamous labor camps. His death sentence was commuted to twenty years in prison. He became a "non-person." One of the 20th century's most distinguished scientists simply failed to exist. The circumstances surrounding Vavilov's death remained unclear for many years. His death certificate lists "decline of cardiac activity." Now we know that he died in 1943 of starvation.

Lysenko became a dominant figure in Soviet agriculture, which accounts, at least in part, for decades of food shortages as the collective farms were forced to adopt his scientifically discredited procedures. His methods were adopted in 1958 by the People's Republic of China, resulting in the Great Chinese Famine of 1959-1962. His fall from grace began when Nikita Khrushchev, who had supported him, was ousted. Andrei Sakharov, their leading nuclear physicist delivered a scathing denunciation of his views before a meeting of the Soviet Academy of Science. In a recent article in The Atlantic, Sam Kean notes that, "... Trofim Lysenko probably killed more human beings than any other scientist in history" and alarmingly that his bogus ideas are regaining popularity in Russia.

A few years later, the Soviet government would not only acknowledge that Vavilov had existed, but it restored his reputation and accorded him great honors. "*His outstanding scientific research and the theories he proposed, his productive scientiic expeditions to all parts of the world, his tremendous organizing activities, his brilliant leadership of the largest scientific institutions, and his whole unrepeatable life was given in selfless service to his Motherland will never be forgotten by his descendants."* [Piroda, an organ of the Soviet government, 1967]

Scientific institutes in Russia bear his name, as do streets in Moscow and St. Petersburg, along with a Russian state university, a minor planet (2862 Vavilov) glaciers, and a crater on the lunar surface, named for him and his brother.

TIMELINE: N. I. VAVILOV

1887 Born in Moscow (13 November)
1906 Graduates from highschool; enters the Petrovske Academy of Agricultural Sciences
1910 Presents his graduation thesis on snails
1911 Works at Bureau of Applied Botany and at the Bureau of Mycology & Phytopathology
1912 Marries Yekaterina Sakharova
1913 Studies in Europe and England; collaborates with William Bateson [to 1914]
1916 Expedition to Persia (Iran)
1917 Becomes Professor of Agronomy at the University of Saratov [to 1920]
1917 Publishes “On the Origin of Cultivated Rye”
1919 Publishes “Theory of Immunity of Plants to Infectious Diseases”
1920 Publishes “The Law of Homologous Series Hereditary Variability”
1921 Expedition to Canada and a number of U. S. states [to 1922]
1921 Lenin appoints him Director of the Bureau of Applied Botany
1921 Expeditions to European Russia, the Caucasus, and Middle Asia [to 1940]
1922 Publishes “Law of Homologous Series”
1922 Becomes corresponding member of the Academy of Sciences of the U. S. S. R.
1924 Becomes Director of the Lenin All-Union Academy of Agricultural Sciences in Leningrad
1924 Expedition to Afghanistan
1925 Expedition to Khoresm (Khwarazm) in Central Asia
1925 Awarded the N. M. Przhevalsky Gold Medal by the Soviety Geographical Society
1926 Publishes “Centers of Origin of Cultivated Plants”
1926 Expedition to a number of Mediterranean countries [to 1927]
1926 Divorces his wife and becomes common-law husband of Yelena Barulina
1927 Expedition to mountainous regions in Bavaria
1928 Receives the Lenin Award (one of the first to be so honored)
1929 Expedition to China, Japan, and Korea
1929 Along with other agronomists, meets with Joseph Stalin; it did not go well
1930 Becomes Director of the Inst. of Genetics, Academy of Sciences of the USSR [to 1940]
1930 Expeditions to the U. S., Mexico, and Central America
1931 President of the All-Union Geographical Society
1932 In his last foreign trip, visits United States, Cuba, and South America [to 1933]
1935 Elected Chairman of the International Congress of Genetics [cancelled by Politburo]
1935 Publishes “Theoretical Basis of Plant Breeding”
1936 Stalin cancels International Congress of Genetics session planned for Moscow
1937 Declared an “enemy of the people” by Trofim Lysenko
1938 Visits United States
1938 Replaced by Lysenko as President of Academy of Agricultural Science
1939 Elected President of International Congress in Edinburgh [Politburo forbids him to attend]
1940 His seed collection, the largest in the world, now numbered 200,000 accessions
1940 Elected a foreign member of the Royal Society of Great Britain
1940 Arrested and interrogated for being a spy for England and on other charges [1941]
1941 Sentenced to death
1942 Sentence commuted to twenty years in prison
1943 Dies in Soviet labor camp at Saratov (26 January), from a “decline of cardiac activity”
1948 Lysenko’s theories become official Soviet state policy
1955 Retroactively pardoned by Nikita Khrushchev
1956 Soviet Academy orders the republication of Vavilov’s works
1965 Academy of Sciences of the USSR establishes the Vavilov Award
1965 His old nemesis, Trofim Lysenko, falls from power
1967 An issue of Piroda of the Academy of Sciences of the USSR praises Vavilov
1968 Academy of Sciences of the USSR establishes the Vavilov Medal
1968 Research Institute Plant Industry renamed N. I. Vavilov Institute of Plant Industry
1987 Russia issues postage stamp honoring Vavilov
1987 Soviet Union marks the centenary of his birth at Central Concert Hall in Moscow
1997 Monument to Vavilov unveiled on the street bearing his name in Saratov

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