Angeles

Seed Bank

Josef Stalin faced a major geopolitical dilemma in 1939. Following the thorough ideological purges of experienced military officers throughout the 1930s, the Soviet Army was in no position to fight a war. Unsure of assistance from the Western powers, he opted to cut a deal with Hitler's Germany. The two countries pledged nonaggression against the other for ten years, and Germany would not object to the Soviet occupation of eastern Poland and the Baltic states. The foreign ministers inked the Molotov-Ribbentrop Pact on 23 August 1939. One week later, Hitler invaded Poland, and the Second World War officially began.

Hitler broke the treaty in June 1941 with Operation Barbarossa, an invasion of the Soviet Union, with Army Group North heading straight for Leningrad[1] [2]. Professor Iosef Orbeli, chief curator of the world-renown Hermitage Museum, sought instructions from Moscow on protecting the invaluable treasure stored in the museum. After two weeks of no response from his superiors, Orbeli made the decision himself to evacuate the enormous, and priceless, collection. In early July, the first load of 22 train cars, under armed guards and loaded with the treasures of the Hermitage, sped eastward to a storage facility in the Ural Mountains.

Across St. Isaac's Square from the Hermitage stood a nondescript government building with treasures unknown to the outside world but even more valuable than in the Hermitage. But its director was away and could not be reached, and

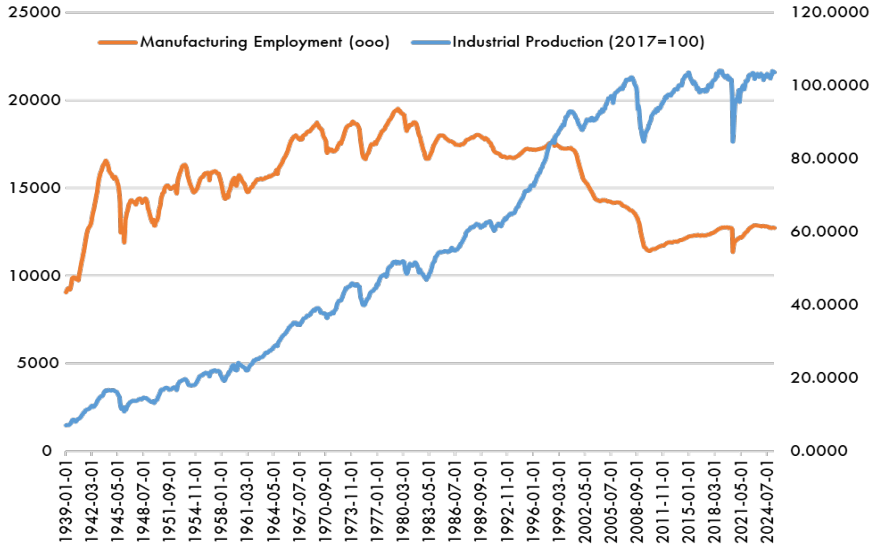
[1] Formerly, and now , St. Petersburg.

[2] Photo credit: RIA Novosti archive, image #2153 / Boris Kudoyarov / CC-BY-SA 3.0.

its bureaucrats waited for word from Moscow on what to do as the Nazi blitzkrieg drew closer.

From the ashes of the Second World War, the United States established the institutions and values that brought unprecedented prosperity throughout the world. Foreign aid and free trade, liberal immigration, universal education, investment in scientific research were the foundations of our shared wealth. At a time when the value and validity of our foundational structures are being challenged, the example of a visionary scientist and his heroic colleagues hold lessons for us today.

Chart 1 **Industrial Production and Manufacturing Employment,**



Source: Federal Reserve and Bureau of Labor Statistics

It may be intuitively appealing that imposing tariffs on imported goods will increase the demand for cheaper domestic goods, thus raising the output and profits of domestic producers and stimulating job creation in manufacturing. Intuitive, appealing, and wrong.

A tariff is a tax on consumption, so it reduces demand, but it is also a tax on business investment, raising costs. More than half of US imports in each of the past eight quarters (2023-2024)[3] were manufacturing inputs. The higher cost of production created by tariffs is borne by a combination of producers, in the form of lower profits, and consumers, through higher prices paid for all goods, not just imported goods. When 50% tariffs were imposed on imported washing machines in January 2018, consumer prices for all, domestic and imported, washing machines rose 12-20%, and by a similar amount for dryers although no tariffs were imposed on dryers. The cost of these tariffs to consumers was approximately $1.5 billion, although an estimated 1,800 jobs in manufacturing were temporarily saved.[4] That's a cost of about $800,000 per job.

Even this jobs saving is misleading. A forthcoming study of the 2018-19 tariffs finds a modest increase in employment across the economy of 0.4% due to import protection, but this is more than offset by a 2% decline in employment due to higher input costs and a 1.1% drop in employment due to retaliation from trading partners, for a net job loss of 2.7% throughout the economy due to tariffs.

Contrary to political assertions, American manufacturing is not declining, in fact, it is near an all-time peak (Chart 1): higher than in 2001, when China entered the WTO, higher than in 1994, when NAFTA was passed. It is true that manufacturing jobs have fallen from a high of 19.5 million in 1979 to just under 13 million today, but this speaks to the surge in labor productivity, to be able to generate more output with fewer workers. Technology and skills account for the rise in output and decline in manufacturing employment, just as we saw in agriculture a century ago.

[3] Between 54% and 56% of imports consisted of industrial supplies and materials, capital goods and automotive engines and parts. Michael Strain, *The Economic Consequences of the Second Trump Administration: A Preliminary Assessment*, published by The Center for Economic and Policy Research.

[4] *The Production Relocation and Price Effects of U.S. Trade Policy: The Case of Washing Machines*, by Aaron Flaaen (Federal Reserve Board), Ali Hortaçsu (University of Chicago), and Felix Tintelnot (University of Chicago), NBER Working Paper No. 25767, April 2019.

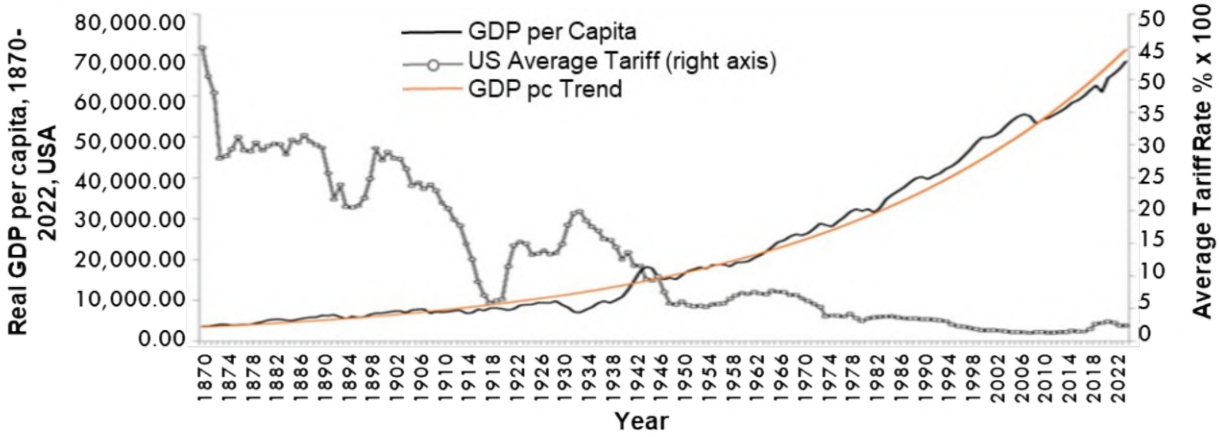
Over the past 150 years, America has become richer as tariff rates have declined (Chart 2). We will become poorer as tariff rates rise.

Poorer still, if we curtail immigration, especially high-skilled immigrants and students. In the near-term, GDP will be lower, by 1.2% to 7.4% over the next three years as the economy struggles with fewer workers.[5]

The long-term consequences are far greater. Immigrants have started more than half of the privately-held unicorns,[6] and 65%[7] of the top AI companies, as 70% of full-time graduate students in AI are foreign-born.[8] High-skilled immigrants make up about 5% of the overall labor force, but 13% of STEM workers.[9] Immigrants hold 18% of doctoral degrees and 30% of patents in strategic industries[10] (Chart 3).

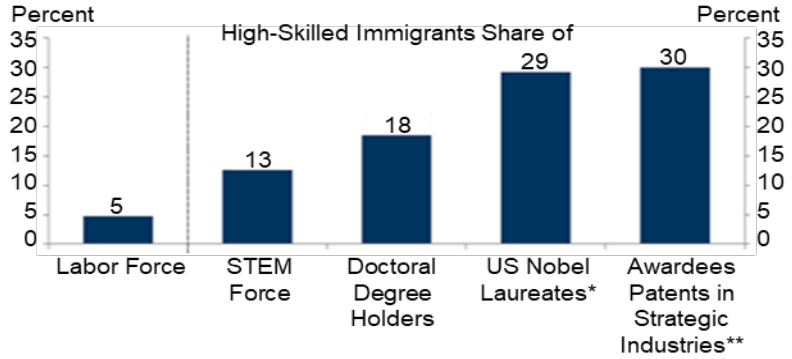
Immigrants produced 23% of the patents between 1990-2016[11] and a 1% increase in the immigrant share of college graduates increases the number of

Chart 2 **US GDP Per Capita and Average Tariff Rate, 1870-**



Source: *Tariffs, Trade Wars, and Economic Policy in Historical Perspective,* Christopher M. Meissner (University of California, Davis)

Chart 3 **High-Skilled Immigrants as Percentage of Selected**



*US Nobel laureates who were not born in the US, 1900-2024. Excludes the Peace price.
**Estimate from Economic Innovation Group which covers patents filed between 2000-2018. Includes industries identified by Brooking Metro as particularly high in both R&D per worker and in the employment of workers in STEM.

Courtesy: Goldman Sachs

[5] The Peterson Institute for International Economics, Working Paper 24-20, *The International Implications of a Second Trump Presidency*, by Warwick McKibbin, Morgan Hogan and Marcus Noland.
[6] Start-up companies valued at $1 billion or more.
[7] 28 of 43.
[8] Source: National Foundation for American Policy.
[9] Source: American Community Survey.
[10] Source: Economic Innovation Group, patents awarded 2000-2018.
[11] Bernstein, Shai, Rebecca Diamond, Abhisit Jiranaphawiboon, Timothy McQuade, Beatriz Pousada, *The Contribution of High-Skilled Immigrants to Innovation in the United States*. NBER Working Paper, 2022.

patents per capita by 9-18%.[12] Immigrants founded 20% of all venture capital-backed start-ups in the past 30 years, with 78% of them arriving in the US for college or graduate school.[13]

Since 2000, 40% of US Nobel Prizes in Physics, Chemistry and Medicine have been awarded to immigrants, a pattern that has been true for a long time. Since 1901, more than one-third of Nobel Prizes in these fields given to Americans were immigrants to this country (Table 1).

Foreign students and high-skilled immigrants have made, and are making, disproportionate contributions to our economic welfare and national security. Their impact can be estimated on employment data and GDP, but the long-term effect of restricting students and immigrants will be incalculably harmful.

Globalization, characterized by free trade and a rules-based order enforced by the reach and might of the US military, created wealth for all participants by encouraging specialization and integration, thus boosting economic productivity. That the US economy and US companies came to dominate this global economic order alongside the uncontested power of the US military was not coincidence: economic power and military power go hand-in-hand, and one is not sustainable without the other.

Possessing the world's reserve currency is an "exorbitant privilege"[14] that accrues to the world's leading economic and military power, enabling it to finance itself cheaply and without risk of default. Military alliances encourage allies to hold more of

Table 1 US Nobel Prize Winners by Category, 2000-2023 and 1901-2023

U.S. Nobel Prize Winners in Chemistry, Medicine and Physics: 2000-2023

Category	Immigrant	Native-Born	Percentage of Immigrant Winners
Physics	17	21	45%
Chemistry	16	23	41%
Medicine	12	23	34%
TOTAL	45	67	40%

U.S. Nobel Prize Winners in Chemistry, Medicine and Physics: 1901-2023

Category	Immigrant	Native-Born	Percentage of Immigrant Winners
Physics	43	71	38%
Chemistry	32	54	37%
Medicine	40	79	34%
TOTAL	115	204	36%

Source: *Immigrants and Nobel Prizes: 1901-2023*, NFAP Policy Brief, National Foundation for American Policy, October 2023

[12] Hunt, Jennifer and Marjolaine Gauthier-Loiselle, *How Much Does Immigration Boost Innovation?* American Economic Journal, 2010.

[13] Amornsiripanitch, Natee, Paul A. Gompers, George Hu, Kaushik Vasudevan, Getting Schooled: *The Role of Universities in Attracting Immigrant Entrepreneurs.* NBER Working Paper, 2021.

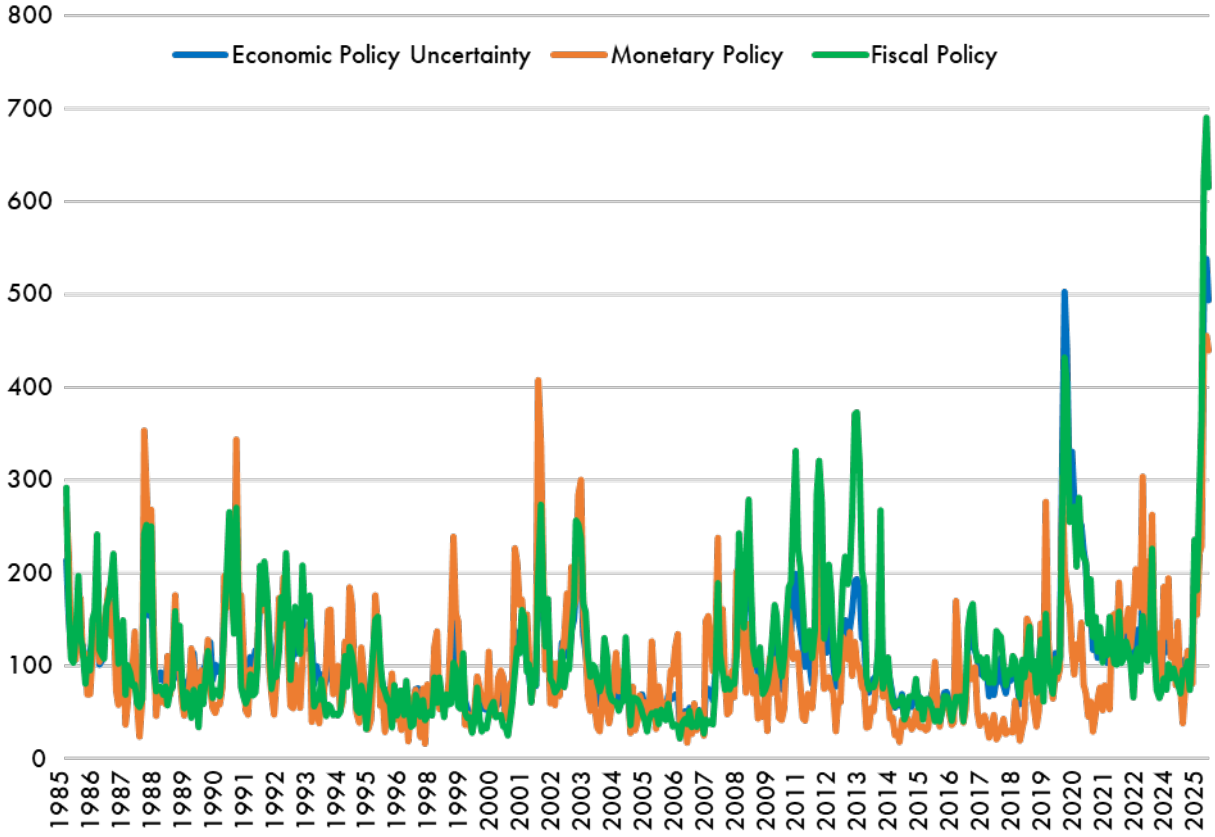
[14] https://www.angelesinvestments.com/insights/investment-insights/1st-quarter-2025-exorbitant-privilege.

the reserve currency, by as much as 30% more in the absence of a military alliance, thus reinforcing the bonds between economic and military power.[15]

For the past decade, to varying degrees, the US has been moving away from this American-centric world order, having determined that the costs and responsibilities are not worth the economic or political benefits. Collective prosperity and collective security have been replaced by transactional pacts that may or may not be honored. Industries and individual companies will be favored or impeded based not on market forces but political dictates. A result of this paradigm shift is unprecedented levels of economic, monetary and fiscal uncertainty (Chart 4).

Heightened levels of economic policy uncertainty create not only spikes in market volatility but have real economic impact. Companies may curtail capital expenditures, investments in productive assets, as multi-year planning for taxes, regulations and ultimate demand become more variable. Economic output, job creation, productivity and profits are all lessened in the face of greater policy uncertainty.

Chart 4 **Economic Policy Uncertainty, 1985-2025**



Source: Measuring Economic Policy Uncertainty by Scott Baker, Nicholas Bloom and Steven J. Davis at www.PolicyUncertainty.com .

[15] *Mars or Mercury? The geopolitics of international currency choice*, Barry Eichengreen, Arnaud J. Mehl, Livia Chitu, NBER Working Paper 24145, December 2017.

Companies, markets and countries that benefitted most from the old global order may not be the winners in this new environment. Investors, too, will have to adapt their playbooks to account for this new, uncertain environment.

Nikolai Vavilov was four years old when a famine ravaged Russia in the winter of 1891-92. It left an indelible impression on the young boy and led him toward a life committed to preventing future famines.

Photo source: RIA Novosti archive, image #764 Boris Kudoyarov CC-BY-SA 3.0

The Russian monk, Gregor Mendel, had published his work with pea plants thirty years prior, demonstrating that traits were inherited intergenerationally. This idea was not widely accepted by scientists, and even Charles Darwin, who was probably unaware of Mendel's research, struggled to explain trait inheritance. But Mendel's work resonated with Vavilov as he sought to apply it more widely.

In 1916, Vavilov traveled to Iran to collect samples of crop seeds new to Russia, including chickpeas, lentils and other legumes. He developed his theory of center of origin, in which plants had an origin and then were modified through cultivation in other locations, now widely accepted as true. He guessed that domesticated crops were susceptible to natural disasters because of inbreeding and lack of genetic diversity (although the concept of genes and genetics had yet to be discovered). He sought to cross-breed domestic plants with wild varieties in order to improve their adaptability and sustainability. Over the next 25 years, Vavilov would make 115 expeditions to 65 countries, collecting 380,000 samples of plants that he brought back to the Bureau of Applied Botany in Leningrad, where he worked and eventually became its director. It was the first seed bank in history.

Unfortunately for Vavilov, the idea that traits were inherited intergenerationally conflicted with Soviet doctrine that people could be molded by the state to be an improved version of themselves.[16] Trofim Lysenko sought to prove that agriculture, in addition to humans, could be adapted to the environment, irrespective of its biological characteristics. He espoused false ideas of science, claiming, for example, that he was able to grow lemon trees in Siberia,[17] but he had the ear of Josef Stalin and was eventually appointed head of Soviet agriculture. Vavilov was a direct threat to Lysenko's efforts to stamp out the "fake" science of Vavilov and his peers and replace it with his own ideas. While on a seed excursion to Ukraine, Lysenko had Vavilov arrested, convicted and sentenced to death in 1941, commuted to 20 years imprisonment the following year. Vavilov was in prison when the siege of Leningrad began, leaving his colleagues to fend for themselves. By the time they decided to try to escape with their irreplaceable collection of seeds, it was too late. They were trapped by the German army.

[16] This was called the *New Soviet Man*.

[17] He couldn't, and didn't.

The Nazi blitzkrieg ground to a halt just outside Leningrad in the harsh winter of 1941-42. The Germans imposed a blockade around the city, hoping to starve the inhabitants into surrendering. For 28 months, the city held out, eating their stockpiles of food, then their pets, then whatever wild animals, birds, or rodents they could catch, and then even their leather shoes and fur coats. Eventually, 700,000 people starved to death in Leningrad.

In the halls of the Bureau of Applied Botany were 380,000 seed samples of nearly every plant, fruit and legume imaginable. The scientists working there had the impossible choice to make: release the seeds to relieve the starvation, or protect this priceless collection for future generations after the war. Each one agreed that they would safeguard this collection to ensure the survival of our species, even if it meant their own deaths. Which it did.

Aleksandr Shchukin, chief curator of legumes, was found slumped over his chair in his office, clutching a packet of almonds. He would have lived had he eaten them. A rice scientist, a potato scientist, nine scientists in total, died at their desks surrounded by the food that would have saved them. The siege was finally lifted in January 1944, too late for these scientists, and too late for Nikolai Vavilov, who died in prison the year before, starved to death.

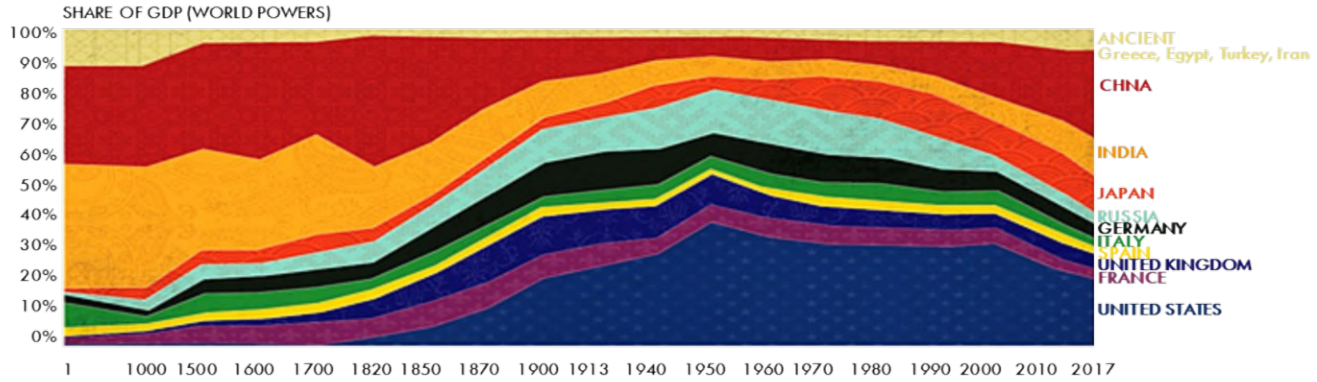
In 1967, the Bureau of Applied Botany was renamed the Vavilov Institute of Plant Industry. By 1979, 80 million hectares were planted with seeds from its original collection, feeding millions. Nikolai Vavilov's vision, and the heroic sacrifices of his colleagues, may have indeed saved agriculture, and with it, the human species. Certainly, his seed bank helped to enable agriculture to feed the billions in future generations.

Vavilov understood the importance of saving the original strains of plants, not to preserve them, per se, but to use them to cross-fertilize with other lines in order to create a more diverse, and stronger, future. The past was valuable only to the extent it could embolden the future.

A young Swiss physician, Johannes Hofer, in 1688 identified an illness prevalent at the time, "grief for the lost charm of the Native Land." The Swiss had a word for it, *heimweh*, or homesickness. But Dr. Hofer gave it a medical term, combining the Greek "returning home" and "pain" in a single word: nostalgia.

Nostalgia is indeed a deadly disease. In the 15th century, China, by far the most powerful country in the world, cut itself off from contact with the outside world in the belief that everything it needed was already produced in China, that there was no idea or invention emanating outside China worthy of their attention. Thus began China's five century relative economic decline, prompted by a belief in its superiority and perpetuated by a nostalgia for its glorious past (Chart 5).

Chart 5 **Global GDP Shares by Country, Year 1 –2000**



Source: Angus Maddison, Visualcapitalist.com

The future belongs to those who embrace new ideas, are open to free exchange and competition, who are guided by scientific facts, not political dogma. Nostalgia for an imagined past and a rejection of foreign ideas, innovations and people lead only to eventual national and cultural decay.

Nikolai Vavilov saw the value of diversity in agriculture, combining the best of the original seed with new ones to create a more vibrant, resilient agricultural portfolio. Similarly, we must recognize the importance of cultivating diverse views, building on our foundational values, when making our own decisions. Vavilov and his colleagues knew that protecting our seed corn was critical for the survival of our species, just as we must protect the framework— foreign aid and free trade, liberal immigration, universal education, investment in scientific research—that has enabled our shared prosperity. The vision, courage and sacrifice of these scientists are inspiration to us today.

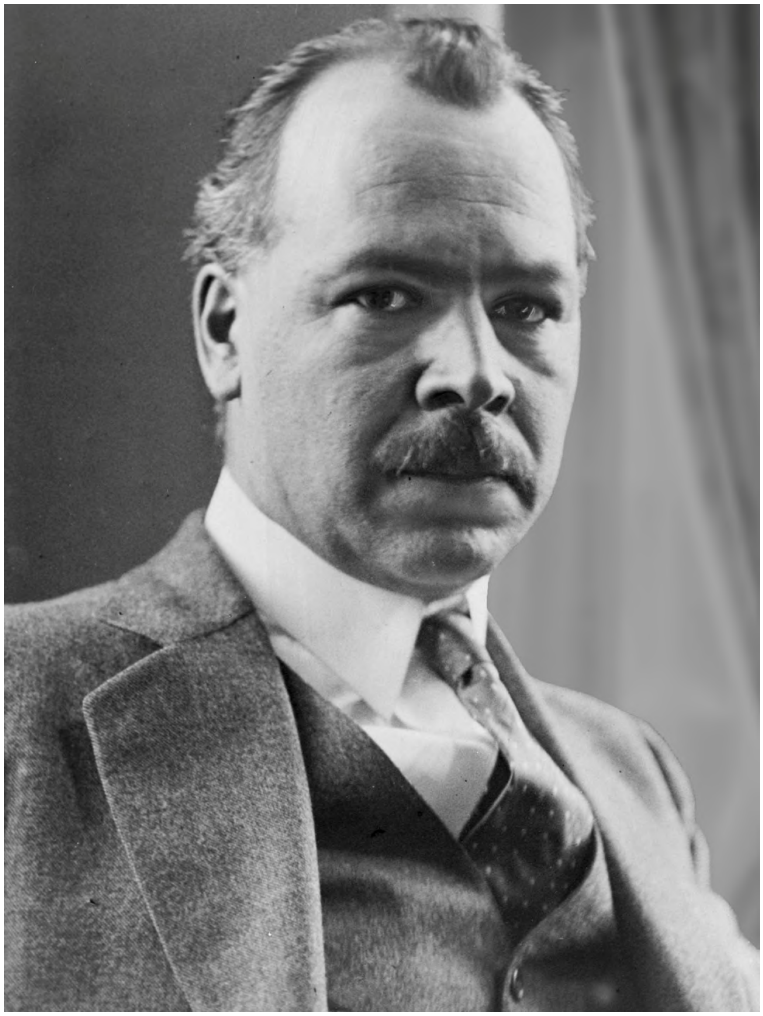


Photo source: Library of Congress

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