Vavilov's Achievement

by Carmelo Ruiz-Marrero

Every modern society needs a substantial public investment in agricultural research. And such research requires the acquisition of useful plant and seed specimens from all over the world. It is no different in the case of socialist societies. During the first half of the twentieth century the Soviet Union was a world leader in the fields of genetics, plant science and the study of agricultural biodiversity, in large part thanks to the colossal work of one single individual: geographer Nikolai I. Vavilov.

Between 1916 and 1940, Vavilov carried out intrepid voyages through five continents collecting seeds of agricultural plants, such as corn, potato, grains, forages, fruits and vegetables, as well as valuable data about the geography of the places he visited and about the languages and cultures of their inhabitants.

Vavilov participated in some 100 expeditions to over 50 countries and collected over 200,000 specimens. No other individual in history has come even close to equaling such a feat. Thanks to his collecting expeditions, the USSR's seed collection was the biggest in the world during his time. These seeds were stored and planted in agricultural research stations distributed throughout the extremely diverse terrains and climates of the Soviet Union. His ideas of agriculture, biodiversity and geography remain to this day so influential that the places of origin of the world's most commonly planted agricultural crops are named Vavilov centers.

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Born in Moscow in 1887 and brother of the world-renowned physicist Sergey I. Vavilov, the young Nikolai worked at the Russian Bureau of Applied Botany from 1911 to 1912. At the time, the Bureau enjoyed great international prestige and esteem in the field of crop diversity studies.

> The Bureau's basic task was to study cultivated crops and useful, weedy or detrimental wild plants of the Russian Empire. Special research projects were conducted on the following agricultural crops: all cereals (wheat, barley, oat, rye, millet, Panicum Sorgfium, rice, etc.); industrial crops including fiber and oil-bearing plants; horticultural crops (cabbage, cucurbits and melons, legumes, root crops, tuber crops, medicinal and aromatic plants, and fruit-bearing plants); as well as wild plants, such as all weeds and pasture plants (grasses, sedges and legumes)... By 1914 the Bureau's collections had been greatly enlarged by accumulating the germplasm requested and shipped from various farms in Russia and by the collecting missions of the Bureau's researchers. [1]

The Bureau's collection had by then some 14,000 seed samples. About half of these were wheat and barley. The rest were mostly oat, rye, pasture grasses, and over 1,000 types of weeds. Plus the Bureau had a herbarium with more than 10,000 specimens collected in different provinces of Russia. [2]

Between 1913 and 1914 Vavilov studied in England with professor William Bateson, one of the main forefathers of modern biology and inventor of the term "genetics."

Back in 1900, when he was developing his concepts of heredity, Bateson ran into an obscure paper written in 1860 by an Austrian monk of the Order of St. Augustine. The monk, Gregor Mendel, had experimented with 29,000 pea plants and made extremely detailed observations of how their traits were inherited from one generation to the next. Bateson became Mendel's advocate, he publicized his work and defended it in the face of competing theories of heredity. Mendelian genetics, which back then was not fully accepted by the scientific community, would exert a great influence on Vavilov's ideas.

Vavilov went on to teach in Saratov University in southern Russia. And in the autumn of 1917, just as the Bolsheviks seized power in the "10 days that shook the world," Robert Regel, head of the Bureau of Applied Botany, made Vavilov the institution's deputy head.

> As Regel wrote in his reference letter, "In the person of Vavilov we will employ ... a talented young scientist who would become the pride of national science." Regel's prediction turned out to be true. Since then, all Vavilov's life and creative work have been inseparable from the world's largest crop research institute, into which he transformed the Bureau in the 1920–30s. [3]

The USSR's seed collection was the biggest in the world.

The Bolshevik government renamed the Bureau the Department of Applied Botany. Vavilov took Regel's place as head of the Department after his death in 1920. He then moved to Petrograd, the city that would later be renamed Leningrad and is today called St. Petersburg, together with the Department's students and associates. In 1924 the institution's name was changed once again, this time to Institute of Applied Botany. In 1926 Vavilov founded the Pavlovsk Research Station, some 30 kilometers south of Petrograd, near the

Tsar's former summer palace, which went on to become the world's top agricultural research station.

His travels

From 1905 to 1915, Vavilov participated in botanical expeditions all over Russia's territory, from the European region all the way to Siberia. In 1916, in the middle of a world war, the Russian Tsar's Agriculture Ministry sent him to Iran and to Central Asia's majestic Pamir mountains, where the famed Silk Road used to run. He came back from this trip with valuable samples of legumes, including chick peas, lentils, peas, beans and clover. [4]

Agricultural biodiversity was very unevenly distributed in the world.

In 1921, when the Russian civil war had not even ended, Vavilov traveled to the Western hemisphere for the first time, visiting Canada and the United States in search of drought-resistant specimens, and on his way back stopping in England, France, Germany, Poland, the Netherlands and Sweden.

In 1924 he organized an expedition to Afghanistan, which became a true feat of Soviet geography. In this trip he determined that the country was a primary focus of crop formation, with a great diversity of major euroasiatic crops. The journey, full of hazards and vicissitudes, earned him the prestigious Przevalski medal of the Russian Geographic Society, which he would direct from 1931 to 1940. [5]

Between 1926 and 1927 Vavilov collected seeds in Syria, Palestine, Transjordan, Algeria, Morocco, Tunisia, Egypt, the banks of the Nile river, Ethiopia, Eritrea, Yemen, Cyprus, Crete, Sicily, Sardinia, Portugal, Spain, France and Greece. In this trip he took note of the great importance of legumes, especially chick peas, in nourishing both humans and farm animals and improving soil fertility. In 1929 he went to China, Korea and Japan's three major isles. In 1930 he returned to the United States, visiting Florida, Louisiana, Arizona, Texas and California, and then going south to Mexico, Guatemala and Honduras.

In 1932, using the occasion of the Sixth International Genetics Congress in the American city of Ithaca, Vavilov traveled through some 18 western states, from Washington and Oregon in the northwest corner, to Louisiana and Arkansas, from California and Arizona in the southwest to the Dakotas, and all states in between, and trekked through Canada from the Pacific coast all the way to Ontario. After that he went to Cuba, Yucatan, Ecuador, Peru, lake Titicaca, Bolivia, Chile, Brazil, Argentina, Uruguay, Trinidad and Puerto Rico. This was to be his last overseas voyage.

His theory

Vavilov noticed in his travels that agricultural biodiversity was very unevenly distributed in the world. While some places had an overwhelming diversity of plants, others had not much to offer. In the Mexican state of Oaxaca, for example, it is not unusual to find campesino garden plots with more corn varieties than in all of the United States, or indigenous farms in Peru and Bolivia with more potato varieties than in all of Europe. Vavilov decided to learn the cause of this phenomenon.

He concluded that the places with the most agricultural biodiversity have varied topographies, soil types and climates. Even more importantly, these tend to be surrounded by mountain ranges that constitute formidable geographic barriers. Mountains, like oceans, are an isolation factor that protects against the untimely invasions of exotic species, which tend to reduce biodiversity.

Vavilov determined that the world's agricultural biodiversity comes mostly from eight identifiable nuclei, which include China, Mexico-Guatemala, the Mediterranean basin, Indo-Burma and Central Asia. He referred to these as the centers of origin. Scientists today call them the Vavilov centers of diversity. Vavilov centers are irreplaceable centers of biodiversity and are essential for world food security. Any agronomist who wants to improve crop varieties must have access to specimens from their centers of origin. For example in the case of the potato, regardless of whether it is grown in Poland, Ireland or Idaho, it needs the genetic input of the extremely diverse varieties that grow in its center of diversity in South America's Andes.

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Quoting from Pat Mooney's and Cary Fowler's seminal book *Shattering*:

> Genetic variation — the diversity created by thousands of years of agriculture — was not equally distributed around the globe. In a small, isolated pocket on the Ethiopian plateau, Vavilov found hundreds of endemic varieties of ancient wheat. Studying other crops, he found some regions blessed with astonishing diversity, while other areas were relatively impoverished. In the following years, observations by other scientists confirmed Vavilov's budding theory. While living in a suburb of Guadalajara, Mexico, Edgar Anderson noted that he found "more variation in the corn of this one little township than in all of the maize in the United States."
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> Vavilov mapped out the distribution of this diversity for each of the crops he studied. He reasoned that the degree of diversity was indicative of how long the crop had been grown in that area. The longer the crop had been grown, the more diversity it would display. . . . By locating a center of genetic diversity for a crop, one pinpointed its origin, Vavilov reasoned. This was where the crop had originated and had had time and opportunity to de-

velop wide diversity. A plant's "'center of diversity' was thus its 'center of origin, '" he said. [6]

His enemies

Vavilov's story does not have a happy ending. The great heroes of science tend to have great enemies. Vavilov's own personal Lex Luthor was the Ukrainian pseudo-scientist Trofim Lysenko, who argued that genetics was a bourgeois science that aimed to provide a biological justification for class differences. Lysenko rejected the Mendelian ideas championed by Bateson and Vavilov and in their place favored an extreme interpretation of the theories of French biologist Jean-Baptiste Lamarck. Anxious to win Stalin's favor, Lysenko unleashed a campaign of slander and abuse against Vavilov and his "counterrevolutionary biology." In August 1940 Lysenko and his followers were finally able to persuade the authorities to arrest Vavilov and take him away to the gulag.

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"Vavilov, the symbol of glory of national science, is at the same time the symbol of its tragedy. As early as the beginning of the 1930's his scientific programs were being deprived of governmental support. In the stifling atmosphere of a totalitarian state, the institute headed by Vavilov turned into a resistance point to the pseudo-scientific concepts of Lysenko. As a result of this controversy, Vavilov was arrested in August 1940, and his closest associates were also sacked and imprisoned. Vavilov's life ceased in the city where his star had once risen. He died in the Saratov prison of dystrophia on January 26, 1943 and was buried in a common prison grave." [7] After Vavilov's death, his prized seed collection was no longer under the custody of rea scientists. Stalinist orthodoxy reigned supreme a Lysenko and his followers ran amok with the proverbial chips on their shoulders. The seed collection deteriorated as a result of neglect, and even today the Pavlovsk Research Station and Russian agriculture have yet to fully recover from the blow.

And then came the Nazis

Stalin's disdain for Vavilov's work was made manifest in 1941 with his refusal to protect his seeds from the advancing Nazis. The Soviet leader ordered factories in the path of the invaders to be dismantled and reassembled in safe territory east of the Ural mountains, but did not do likewise for the seed collections. However, unlike Stalin and Lysenko, the Nazis did appreciate the importance of those seeds.

The German SS had a unit called Ahnenerbe, made up of intellectuals, scientists and explorers, kind of a Nazi version of National Geographic. Theorizing that all of human history had been little more than a struggle between Nordic and Semitic peoples (the latter being, of course, the "bad guys"), Ahnenerbe sent out a number of anthropological expeditions to various locations before and during World War Two. Its expedition to Tibet in 1938–1939, was immortalized in a book written by one of its members, Heinrich Harrer, titled *Seven Years in Tibet*. It became an American bestseller in 1954 and was made into a film in 1997.

Ahnenerbe's leadership knew about Vavilov's seeds, understood their priceless value and intended to seize them in order to give the Third Reich unrivaled supremacy over world agriculture (not very different from what Monsanto intends to do nowadays). Nazi intellectuals interpreted Mendelian genetics as validation of Nazism's concepts of racial purity.

In June 1943, in the wake of the Germans' defeat at Stalingrad, Ahnenerbe sent a detachment to Ukraine led by botanist Heinz Brücher to get hold of the Soviet seed collections. The captured seeds were taken to an Austrian castle near the city of Graz.

But the majority of Vavilov's seeds were stored at the Pavlovsk Research Station. The city was besieged by the Nazis for two and a half years, and its resistance was one of the most heroic episodes not only of World War Two, but of the twentieth century. The Germans seized the Pavlovsk station but Brücher's unit did not find the coveted seeds. These had been moved by Vavilov's colleagues to a location within the city. They guarded them with their lives, as they knew full well that if the Nazis ever captured them all of Vavilov's work would be lost forever, and if they won the war they would not have seeds with which to regenerate Soviet agriculture. They also had to protect the seeds from the hungry population — over one million people died during the siege, many of them of starvation. At least a dozen scientists starved to death while guarding the seed collection.

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> In the spring of 1943 the defeat of the sixth army in Stalingrad sealed the fate of the Eastern front and signaled the start of the German retreat. The deaths of over 127,000 soldiers and the capture of another 90,000 by the Soviet army worried the German high command. But something else called its attention. Biological field stations, spread between Minsk and the Crimean peninsula, in territory still occupied by the Germans, would soon fall into Russian hands. The seed collections in some of these stations included, apart from improved varieties and local samples, duplicates of the collections that Vavilov had compiled during his expeditions all over the world.
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> On June 16 1943 Brücher and a detachment of special troops initiated the recovery of these collections. At the Sinelnikovo station they found duplicates of the world collection that Vavilov had put together in Leningrad and, among many other

things, many samples of corn varieties from Mexico and Central America... In the summer of 1943 Brücher planted several samples of barley and wheat, concluding that by 1945 he would have improved seeds.

This story has more than one connection with Mexico. In the 'rescued' collections in the stations in Ukraine there were samples of corn, beans, and other crops that originated in (Mexico), taken by Vavilov to Leningrad. The duplicates in Sinelnikovo included diverse landraces of Mexican corn. [8]

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The irony of it all was that while Brücher accorded great value to these collected seeds, the Soviet authorities preferred Lysenko's ideology and his primitive Lamarckism.

The Soviets defeated the Nazis. The Germans never took Leningrad and never got their hands on the Pavlovsk station seeds. The stolen seeds from Sinelnikovo and other stations were recovered, and on top of that the Soviets took control of Germany's Gatersleben agricultural station, which housed a seed collection whose first samples were collected in the days of the Kaiser.

Brücher survived the war and migrated to South America. In 1948 he was named professor of the University of Tucuman in Argentina and in the years that followed he also taught in Paraguay and in the Argentinean cities of Mendoza and Buenos Aires, and authored several books on botany and agriculture. His murder in Mendoza in 1991 is the subject of several conspiracy theories. [9]

Vindication

After Stalin's death, members of the Soviet scientific community started to speak openly against Lysenko. In 1962 physicist and astrophysicist Yakov B. Zel'dovich, astrophysicist Vitaly L. Ginzburg, a Nobel prize winner, and physicist Pyotr L. Kapitsa, also a Nobel laureate, publicly declared that Lysenko's work was a fraud. Two years later, nuclear scientist Andrei Sakharov, who would win the Nobel peace prize in the following decade, accused Lysenko of pseudoscience and defamation and held him responsible for the firings, arrests and deaths of real scientists. [10]

Lysenko died in 1976, discredited and disgraced. Today his theories are generally considered fraudulent. Quite deservedly, Lysenko lived to see Vavilov posthumously exonerated of all charges against him and given due honor. In 1968 the Institute of Applied Botany that he led was renamed after him.

His legacy lives

Vavilov's feat was never repeated. No other individual has ever launched an effort of similar proportions to collect, catalogue and classify the world's agricultural biodiversity. His theories about the geographic distribution of crop biodiversity have passed the test of time and are accepted by biologists and agronomists all over the world.

The Soviets kept Vavilov's legacy of botanical expeditions alive. In 1991, year that the USSR collapsed, there were Soviet seed expeditions to Egypt, Portugal, the Madeira Islands and Costa Rica. [11]

There were also many expeditions within the vast and astonishingly diverse terrain of the Soviet Union. In a single year, 1986, explorers from the Vavilov Institute collected seeds from Kaliningrad, Astrakhan, Ukraine, Crimea, Moldavia, Georgia, Azerbaijan, Uzbekistan, Tajikistan and Sakhalin island in the Pacific Ocean just north of Japan. There were also many instances of cooperation with other socialist countries. There were expeditions to Poland, Bulgaria, Czechoslovakia and East Germany with the full participation of local agronomists and botanists. And in 1990 Mongolia received a joint USSR-Czechoslovakia-Bulgaria seed expedition with local experts, that searched for forage grasses and wheat. The Soviet Union also received expeditions from these socialist countries. In 1981, for example, Soviet and Polish scientists collaborated in searching for seeds in various Soviet territories, including Krasnodar, North Ossetia, Dagestan, Azerbaijan and Georgia, and obtained 350 samples of cereals, legumes and forage grasses. [12]

The expeditions continue to this day. In September and October 2011 the Vavilov Institute sent out an expedition to the former Soviet republic of Tajikistan, which obtained samples of local melon, gourd, watermelon, cucumber, carrot, tomato, onion, beet, radish, basil, celery and dill. This venture was jointly carried out with two private Dutch companies, which seems to indicate that the Institute is turning to public-private partnerships in order to make up for poor public funding. [13]

His theories about the geographic distribution of crop biodiversity have passed the test of time.

After facing formidable foes like the Third Reich and Lysenko's pseudoscience, Vavilov's work keeps finding new enemies. In 2010 part of the Pavlovsk agricultural station was going to be razed by a developer who wanted to build houses there. The station and its 1,200 acres of fields can rightly be considered one of the marvels of the modern world.

The Pavlovsk Research Station houses one of the world's largest collections of seeds and planted crops, roughly 90% of which are found in no other scientific collection in the world. The station's inventory includes almost a thousand types of strawberries from more than 40 countries; a similar number of black currant varieties from 30 countries, including North America, Europe and the Far East; 600 apple types collected from 35 countries; and more than a hundred varieties each of gooseberries,

cherries, plums, red currants, and raspberries. More than half of the black currant varieties grown in Russia, the world's leading producer, were bred at Pavlovsk. Sales of black currants in Russia are valued at more than $400 million annually. [14]

After an urgent international campaign for the station's protection, Russian president Medvedev declare he would take a look into the matter. The construction project has apparently been shelved indefinitely.

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Questions for the future

There is no doubt that if he were alive today, Vavilov would be considered a vile biopirate. The times have changed. The last quarter century has seen the rise of a critical consciousness among indigenous peoples, campesinos and the most diverse civil society sectors with regards to how seed collection endeavors carried out over the centuries by great empires and highly industralized societies have resulted in homogeneous agricultural systems based on monocultures, which represent the very denial of biodiversity and sustainability. The disastrous consequences of this mode of agricultural production have been exhaustively documented, at least since the pioneering work of Murray Bookchin and Rachel Carson in the early 1960's. In 2008 the massive and thoroughly documented IAASTD report, comissioned by the United Nations and the World Bank, made it very clear in its conclusions that the current model of modern agriculture exacerbates global warming and world hunger. [15]

Seeds are today an object of conflict and bitter controversy because of the blunt efforts of life sciences corporations to appropriate them through so-called intellectual property rights, which are legitimized by neoliberal ideology and enforced by legally binding free trade agreements. This is why nowadays the mere act of collecting seeds has come under suspicion among many local populations all over the world. Today Vavilov would not be well received in many of the places where he collected seeds.

This leads to several questions to which I hope to find satisfactory answers someday. What is the Vavilov Institute's position on the controversy around biopiracy and patents on seeds? What are its positions on genetically modified crops, organic-agroecological production, food sovereignty, or the findings of the IAASTD report? I harbor no illusions. Agricultural research centers tend to be very conservative in subjects like these, if they address them at all. Critiques of conventional industrialized agriculture do not flow from these research centers. Quite the contrary, these have most often been bulwarks and redoubts of resistance to change.

Maybe the Vavilov Institute has not been the target of protests against the patenting of seed because in this matter the worst offender by far has been the United States and its life sciences corporations, followed closely by their European counterparts. And with the decline of the G7 and the rise of the emerging economies, we'll probably be seeing soon seed expeditions launched from countries such as China, India and Brazil.

If he were alive today, Vavilov would be marching along with the member organizations of Via Campesina and the advocates of food sovereignty and against the Monsantos of the world. At least, that's what I would like to think.

Professor Ruiz-Marrero is a Puerto Rican author, investigative journalist and environmental educator. He is a research associate of the Institute for Social Ecology (http://www.social-ecology.org/), a fellow of the Oakland Institute (http://www.oaklandinstitute.org/), and director of the Puerto Rico Project on Biosafety (http://bioseguridad.blogspot.com/). His bilingual web site (http://carmeloruiz.blogspot.com/) and list server (http://groups.yahoo.com/group/carmeloruiz/) are devoted to environment and development issues of global relevance. His Twitter ID is carmeloruiz.

Notes

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