

Daniel Alcides Carrión — Peruvian Hero and Medical Martyr

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When Daniel Alcides Carrión García died in Lima, Peru, in 1885 at the age of 28, he had never published a scientific paper and did not have a medical degree. Yet more than a century later, he is still considered a national medical hero in Peru, and his name is attached to a major Peruvian medical center near Lima, a province in the Andes mountains, as well as a University and the highest-altitude football stadium in the world — both in Cerro de Pasco, the small mountain city where he was born in 1857.

Carrión was the son of a physician: his father, Baltasar Carrión Torres, was Ecuadorian and had graduated from medical school in Quito in 1837. His mother, Dolores García, was from Cerro de Pasco and had a liaison with Baltasar during a trip he took to that city. Although Baltasar was married to another woman back in Ecuador, he eventually accepted paternity of Daniel and provided for the boy. Baltasar died from a gun accident while riding a rambunctious horse when Daniel was 8 years old, and young Daniel was then sent away to live with relatives of his mother. At the age of 14, he moved to the city of Lima and entered the Colegio de Nuestra Señora de Guadalupe. He began studying at Faculty of Medicine of the Universidad Mayor de San Marcos in Lima in 1878, but difficult economic conditions resulting from the 1879-1883 War of the Pacific (involving Peru, Chile, and Bolivia) and study interruptions for military service meant that his progress was slow.

In 1875, a severe febrile illness associated with hemolytic anemia had delayed construction of a critical rail line from the coastal city of Callao (near Lima) to the mining town of La Oroya in the Altiplano (Andean Plateau) in central Peru. Hundreds of railroad workers died from what soon became known as “Oroya fever,” and it became a national priority to understand this ailment. Although several contemporary medical experts suspected a link to a

peculiar cutaneous malady seen in the same region, “Peruvian warts” — *verruca peruana*, an endemic yet not contagious ailment that had been recognized since pre-Inca times — there was no direct proof of a connection.

Carrión was required to prepare a thesis to graduate from medical school, and he decided to study *verruca peruana*, which he had first encountered as a boy in Cerro de Pasco. Realizing that the key unanswered question about the disease was whether it was linked to Oroya fever (and perhaps wanting to achieve some notoriety at the outset of his career to help overcome his lack of money or political connections), he begged his supervisors at the Hospital Dos de Mayo in Lima to inoculate him with tissue from a skin lesion of an affected patient. His supervisors adamantly refused, so on August 27, 1885, Carrión took matters into his own hands. He used a lancet to scrape material from a bright red, active verruca located near the eyebrows of a 14-year-old boy at the hospital who had recovered from an illness and was about to be discharged (history records both the boy’s name, Carmen Paredes, as well as the ward bed he was in, Numero 5). Because Carrión had difficulty inoculating his own arms with the material from Paredes’ skin lesion, several of his friends, including a young physician named Evaristo Chavez, took the lancet from him and made 4 inoculations, 2 in each of Carrión’s arms. Carrión then took detailed notes on the evolution of his condition.

Although he noticed some brief itching at the inoculation sites the day after the injection, Carrión experienced no further symptoms until 3 weeks later. On September 17, he developed some pain in his left ankle, which resolved the next day, but 2 days later he came down with cramps, fevers, chills, and headaches. By September 22, he was very ill: jaundiced and pale, with dark-colored urine consistent with brisk hemolysis. From September 26 he was too weak to continue to take notes on his own, so his friends continued his research project

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even as they were also attending to him at the bedside. Carrión's condition deteriorated further, and he was admitted at the end of September to Maison de Santé (the French Hospital in Lima), where he was treated with iron salts, quinine, and oxygen. The day before his death, a blood transfusion was authorized by a hospital committee (transfusions were considered extremely dangerous in the era, 15 years before Karl Landsteiner discovered blood types, and were only used in desperate cases), but Carrión died before any blood could be administered. He is buried in a mausoleum on the premises of the National Hospital Dos de Mayo in Lima. There was a brief attempt to prosecute his friends, including Dr. Chavez, as accessories to murder, but the legal case quickly fell apart owing to overwhelming public sentiment. A Peruvian law later declared him officially a "National Hero," and Oroya fever became known as "Carrión's disease."

The geographic distribution of Carrión's disease is limited to Peru, Ecuador, and Colombia, and it is encountered primarily in Andean valleys at an altitude between 500 and 3000 meters. Subsequent investigations demonstrated that the disease is caused by *Bartonella bacilliformis* gram-negative bacteria, which are transmitted by sandflies of the genus *Lutzomyia*. Salmonella superinfection complicated many of the cases historically, and superinfection increases lethality. The disease remains endemic in some rural areas of Peru; an outbreak occurred as recently as 1998, with a mortality rate of less than 1%, compared with 40% to 90% in the era before effective antibiotic treatment. The organism was first observed on a blood smear in 1909 by Alberto Leonardo Barton Thompson, an Argentinian-born Peruvian researcher who gave his name to the bacterial genus. A Japanese investigator, Hideyo Noguchi, flew blood to New York from a patient who died of Oroya fever in Lima in 1926 and was the first to successfully culture the organism and inoculate the bacillus into primates, which resulted in verruga peruana.

Today, Daniel Carrión is recognized both for his risk-taking altruism and as a model of the tradition of medical self-experimentation. Self-experimentation usually occurs when skeptical research authorities deny permission for a risky procedure that an individual investigator feels has a high likelihood of success, as in Carrión's

case, or when an experiment is considered too dangerous to ethically perform on someone else. For instance, the first person who German physician Werner Forssman performed a cardiac catheterization on in 1929 was himself, after his department chief refused permission to try the procedure on patients, and US Army physicians from Walter Reed's yellow fever research team in 1900 inoculated themselves intentionally to prove that the disease was mosquito-borne, resulting in death of one young team member, Jesse Lazear. In other self-experimentation cases, the physician is simply the most convenient research subject. Jonas Salk tested his polio vaccine on both himself and his family in the 1950s, while Barry Marshall swallowed the contents of a Petri dish containing cultured *Helicobacter pylori* in 1984 after experiments with the organisms in piglets failed. In 1950, William Harrington injected himself with 500 mL of blood from a patient with immune thrombocytopenic purpura to prove the condition was serologically transmitted (and he suffered a seizure as a result), while Joseph Goldberger in 1914 injected himself with blood from a patient with pellagra (niacin deficiency) to prove that it was not an infectious disease. In the early 17th century, Santorio of Padua lived on a platform scale for 30 years, to carefully measure his weight, oral intake, and his urine and stools, and thereby demonstrated the concept of "insensible losses" via perspiration. Sometimes self-experimentation is done for personal benefit: Swiss chemist Albert Hoffman repeatedly experimented on himself with the hallucinogen LSD after accidentally ingesting some via his fingertips, while pharmacologist Albert Heffter did the same with mescaline from the peyote cactus in the 1890s.

Daniel Carrión has been honored philatelically by Peru several times, including Scott No. 1594 (2007, the 150th anniversary of Carrión's birth), Scott No. C149 (1957, the 100th anniversary of Carrión's birth), and Scott No. 1402 (2004, as part of a series of scientists and inventors). Notably, although Carrión's facial features as depicted in these stamps were characteristic of indigenous Andean populations, photographs of him in published articles have often been retouched to make him appear more European, reflecting Peruvian social stratification.