To the casual Peruvian observer of 1885, Daniel Carrion might have seemed an unlikely health pioneer. He was then 26 years old, a sixth-year medical student of modest means studying an obscure disease in a country just recovering from foreign occupation that was ill-equipped for medical research.

In those days, Lima medicine was limited. The number of well-trained physicians was small, and while a movement to modernize and improve Peruvian medicine had made strong progress under a physician named Cayetano Heredia in the 1860s, by the 1880s that movement had run its course.

Moreover, modern medicine based on things as fundamental as the germ theory was only beginning to emerge in Europe in the 1880s. So it is not surprising that the small city of Lima had no laboratory, only a few microscopes, and hardly any of the basic equipment needed for medical research—or that few Peruvian medical researchers were pursuing anything but armchair theory.

Beyond that, Peru was battered. War with Chile had broken out in 1879, and while the Peruvian army was not immediately routed, Chile succeeded in taking large strips of southern Peru, destroying the Peruvian Navy, and blockading the Peruvian coast. In January 1881 the Chileans attacked Lima, and after a brief final battle at Miraflores on the city’s outskirts the defenders were put to flight and the victorious Chileans occupied the Peruvian capital. This occupation, which lasted until 1884, saw the main university (the University of San Marcos) ransacked and Peru’s National Library destroyed.

These conditions posed big obstacles for Carrion. He did not come from one of Lima’s leading Spanish families—normally a must for medical fame and fortune in those days. He did not come from Lima at all. He was a child of the Andes. Possessing a mixed racial heritage and considerable Indian blood, he was born in 1858 at Cerro de Pasco, a hub of the Peruvian mining industry perched high in the mountains at 14,000 feet.

We know little of his father, a physician from Ecuador named Baltasar Carrion who practiced in Cerro de Pasco, and even less of his mother, referred to by one writer as "the respectable woman
Doña Dolores Guerrero; but we know enough of the land where he spent his early years to make some obvious deductions about his life.

That land, the high sierra of Peru, sweeps through the country in a majestic eastward-angled band from north to south, leaving only Lima and a narrow coastal desert to the west and tropical lowlands to the east. When Daniel Carrión was a boy, people used mostly donkeys, mules, and llamas to get around; and the mountains, rising steeply to peaks above 20,000 feet, made travel perilous and slow.

Cultural differences intensified the isolation. Most highlanders were Indians with strong roots in the Inca or Aymará cultures conquered by the Spaniards. They distrusted Lima's European ways at least as much as aristocratic Limeños disdained the highlands. So they ignored the official government as much as possible, wrapped the remains of their ancient cultures around themselves like a blanket, and pursued lives not too different from those they might have pursued had the Spaniards not arrived.

This grand isolation was reduced in places like Cerro de Pasco, where mineral wealth created traffic to and from the coast; and it was much reduced among people like Baltasar Carrión—who came from elsewhere, had a professional background, identified with European ways, and could afford to travel. Nevertheless, for a child reared at Cerro de Pasco in the 1860s, the sierra could not help but engender special feelings about one's origins, place, and roots; for the mountains were impressive, the Indian culture was all-pervasive, and Lima was far away.

Even in those days, however, things were changing. Beginning in 1868 a North American promoter and engineer named Henry Meiggs started building rail lines for the Peruvian Government. One of them, a standard-gauge line completed in the early 1870s, climbed straight up the Andes from Lima to reach the mining towns of La Oroya and Cerro de Pasco—an audacious and unprecedented feat of engineering.

Building this line wasn't easy. Costs were high, technical problems abounded, and in 1870 a mysterious ailment that became known as Oroya fever descended on Meiggs' workers and slew roughly 7,000 in the mountains. Despite this the line was finished; and for those who could afford to pay, it provided reliable and rapid transportation between Lima and Cerro de Pasco, moderating the enforced isolation of highland life.

The line's completion in the early 1870s...
probably played a role in Baltasar Carrión’s decision to send his son to school in Lima—because it allowed frequent and safe journeys back and forth. Be that as it may, in 1873 Daniel was sent to Lima to attend the Guadalupe boarding school, where he established a good reputation as a student. He also made periodic visits home, often traveling in the company of an uncle, Manuel Ungaro; and it was apparently during these trips that he first became strongly aware of the disfiguring disease called “ verruga peruana” (literally, “Peruvian warts”).

This was an old highland ailment. Surprisingly accurate representations of its characteristic nodules appear on the clay people and animals of native ceramic pots known as “ huacos ” that predate the Spanish Conquest. The Quechua-speaking Indians of the region called it “ Kceppo ” or “ Sirki .” Early Spanish colonists in Ecuador described something very like it. And a broad range of colonial and later writers talked about it, calling it by various names (including “ berrugas ” and “ warts of the Andes ”) before settling on “ verruga peruana .”

The disease’s name belied its severity. Verruga peruana did not start with warts. It started with fever and anemia, mimicking malaria symptoms so closely as to commonly cause misdiagnosis of both ailments. Then, as the anemia and fever began to subside, recurrent pains arose—most notably in the muscles, bones, and joints—that could become severe:

These pains are generally rheumatoid and worsen at night. They invade the joints one by one, usually starting in a knee or in a small joint of the foot or hand. They spread and intensify in proportion to the severity of the disease, its duration, and the climate . . . it being observed that in cold places the pains are extreme.

The rachialgia and myalgias . . . are at times so intense as to make some muscles rigid, leading to torticollis, opisthotonos, and a more or less permanent contracture of upper and lower limbs which, together with the arthralgias that immobilize the joints, lock victims in unnatural positions.

In severe cases, many cannot endure without shouts and moans the extreme pain, whose every increase provokes new and intense suffering.4

As the pains started to abate, anywhere from three weeks to eight months after the first symptoms, vivid red to purple-colored nodules, the verrugas, typically began emerging on the patient’s face, arms, legs, trunk, mucous membranes, or internal body parts. These verrugas could be messy. Unlike ordinary warts, they consisted largely of proliferating vascular tissue; and as one might expect from their appearance and composition, they tended to break, bleed, and get infected. Sometimes only a few peaseized verrugas appeared; but sometimes small ones would carpet the arms or legs; or bloody, debilitating growths as big as tennis balls would emerge, inviting secondary infection and demanding surgical intervention.5

Fortunately, these verrugas were transient. In anywhere from a month to two years they would disappear, leaving scant evidence of their former presence. But they could recur. Suffering from the disease once did not necessarily free victims from the possibility of subsequent attacks, and there were reports of people having had verruga peruana repeatedly for many years on end.6

Today we know these troubles are caused by a polymorphous bacterium, Bartonella bacilliformis, first identified by

6Ibid., pp. 772-74.
the Peruvian physician Alberto Barton in 1905. This microbe, which mainly attacks red blood cells, spreads from person to person through the bite of a vector, the sandfly *Phlebotomus verrucarum*, that breeds in fast-moving streams and is active at night.

The sandfly’s breeding waters typically run along the bottoms of narrow Andean valleys at altitudes between 2,500 and 8,000 feet; and while the small adult flies easily penetrate mosquito netting, their range is limited. Of course, anyone living in endemic valleys and sleeping within flying range of the streams runs a high risk of infection; but other highland residents living out of range run only a slight risk or none at all.

Modern antibiotics—penicillin, streptomycin, chloramphenicol, and tetracyclines—can cure the disease in its early stages by killing the invading bacteria. Beyond that, an understanding of how the disease spreads helps both travelers and highland residents to avoid endemic zones. This provides a basis for effective treatment and prevention; and so, while the disease persists, it afflicts mainly highlanders who are not informed or determined or cautious enough to avoid infection, together with visitors from the coast or foreign lands—who may return to Lima or their own countries before developing symptoms that can present physicians with a considerable diagnostic challenge.

Of course, no antibiotics existed in Carrión’s day, and nobody knew what caused the disease or how it spread. He himself never caught it as a child; and Cerro de Pasco was outside the main transmission zones, so there may have been few evident cases on the streets. In fact, despite his father’s medical practice, we have no evidence that the younger Carrión was especially concerned about the ailment until he came into more direct contact with it while travelling through *P. verrucarum*’s native haunts.

Carrión succeeded at Guadalupe, and after graduating he entered the University of San Marcos, where he majored in natural science. Also successful there as an undergraduate, in 1879 he sought admission to the university’s San Fernando School of Medicine. He failed the entrance examination on his first try, but in 1880 he tried again, passed, and was admitted.

By then things had become chaotic. Peru was at war. In the year when Carrión began his medical studies in the center of Lima at the Dos de Mayo Hospital—Peru’s best at the time—and the nearby medical school, the Dean of the Medical School became Vice-President of the Peruvian Red Cross, the Medical School Secretary became Surgeon Major of the Army, and many of the school’s professors and students marched off to the front.

Carrión himself served as a health worker at the Battle of Miraflores in 1881, just before the Chileans occupied Lima. The medical school, adjourned for its normal summer recess at the time and possessing one of the few imposing non-religious public buildings in the city, was occupied by the invaders—but not before its books had been spirited away to private homes and the school itself had received government authorization to continue operating elsewhere on an irregular basis.

These actions were needed, because the Chileans saw the university as a trouble spot and tried to interdict it. So for three years, until the Chileans departed in 1884, Carrión and his classmates pursued their second, third, and fourth years of medical study by surreptitiously

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attending medical classes in professors’ homes.

Some compensation for these shortcomings during the war and occupation came in the form of intense practical experience. In fact, Carrión and his fellow medical students were apparently given as much medical responsibility as they could handle, and during their fifth year—after the occupation—were accorded nonresident status at a wide range of medical and surgical services in several hospitals providing charitable relief.

So despite the war and occupation, things went reasonably well. Carrión, who appears to have been popular, acquired a circle of close friends. And albeit in an informal and irregular manner, he acquired a sound medical background.

Eventually, as his studies neared their end, he chose to do his required thesis on verruga peruana and proceeded to explore that subject. This posed certain problems, because by now his interest in the ailment was intense, but his investigative options were limited. In essence, he could read whatever literature was available after the occupation, and he could examine patients. But neither he nor the medical school was prepared to do any carefully controlled studies.

Nevertheless, as Carrión’s work progressed he found his attention drawn to certain questions. In particular, How could early verruga peruana be diagnosed? For those who knew the ailment, late-stage diagnosis was a breeze. The verrugas were distinctive; and although some might at times be mistaken for cancerous growths, in combination with the ailment’s earlier symptoms they provided good grounds for clear-cut diagnosis.

But identifying early cases was a different story. Even the intermediate-stage pains were sometimes mistaken for arthritis, while the early symptoms’ similarity to symptoms of malaria—also present in the Peruvian highlands—posed a widely recognized problem that created serious health hazards for victims of both ailments.

Carrión reasoned that if verruga peruana could be diagnosed early, this confusion might be resolved, and a way might also be found to successfully treat verruga—hitherto an incurable disease. The trouble was, given the virtual nonexistence of clinical research in Lima and his own very junior status, where was he to get his volunteers?

Gradually he became convinced that the best way to study these early symptoms was to perform an experimental inoculation on himself. “I have foreseen the grave mishaps that it [the disease] might cause,” he said; “but is it not also evident that science, and above all medicine, owes much of its progress to risky experimentation? And so, Why doubt the results, which must in any case be good?” In this vein he repeatedly discussed the idea with his friends and professors, who invariably tried to dissuade him.

He had patriotic motives too. “It upsets me immensely,” he told his friends, “to see people like the Chilean physician Izquierdo, who had only a few tumors to examine, venturing opinions, writing about a disease that nobody should bring to light better than ourselves.”

Other events of 1885 increased his motivation. Some important European researchers requested specimens of verrugas, and Peru’s Academy of Medicine arranged a prize competition for contributions on the ailment. Clearly, the time had come to act.

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9Cuerpo Médico del Instituto Sanitas, p. 8.
10Ibid.
On the morning of 27 August 1885 he was in the Nuestra Señora de las Mercedes ward of the Dos de Mayo Hospital. In bed No. 5 was Carmen Paredes, a 14-year-old boy with a verruga on his right eyebrow. The boy was anxious to leave the hospital, and Carrión became concerned lest he miss the chance to inoculate himself during his forthcoming vacation period. Carrión’s teacher, Professor Villar, and three of the professor’s assistants were also in the ward. They all voiced their disapproval of his inoculating himself, but Carrión insisted. Using a lancet he had brought with him, he tried to inoculate his arm with blood taken from the verruga. When Dr. [Evaristo] Chávez, one of the young physicians, saw the difficulty Carrión was having, he took the lancet from him and completed the inoculation.

Nobody knew whether the disease could be transmitted at all, much less in this manner. Also, while verrugas were serious annoyances that could spark complications, verruga peruana was rarely if ever fatal. So nobody took much note of what Carrión had done. No one voiced alarm, Carrión was not disciplined, nothing official happened.

Twenty-one days later, on 17 September, Carrión felt vague discomfort and pain in his left ankle, followed the next day by slight bodily malaise. Then, on 19 September, the disease struck full force—with abdominal cramps, prostration, severe generalized pains, and strong teeth-chattering chills alternating with a high fever that Carrión couldn’t measure because he couldn’t bear making the supreme effort needed to take his own temperature. Writing in his diary afterward, he wrote:

I did not remain much time in the same position, because it soon became intolerable; I was shifting about each moment without finding any comfort or rest.

I had insomnia produced by both the fever and the pains. . . . Finally, around 5 a.m. I slept a little and perspired a lot. . . . At 5 in the afternoon on the twentieth, since I had not eaten . . . I desired to eat, but had such anorexia that the mere sight of food provoked nausea. . . .

My urine was scanty, red in color, dark and with much sediment.

Over the next few days he reported more abundant red urine, jaundice, the appearance of small red spots “resembling flea-bites” on his nose and between his eyebrows, and continuation in one degree or another of the pain, anorexia, thirst, and other symptoms.

On twenty-fourth he noted that “Writing or making any movement causes my right thoracic member to tire quickly, become painful, and experience many cramps.” By the twenty-sixth he had declined to a point where he gave up writing, noting that “From today onward my friends will observe me, since for my part I confess it would be very hard for me to do it.”

On 27 September, friends keeping vigil at his bedside suggested that someone should stay with him at night, to which he responded that this was unnecessary, that his symptoms must correspond to nothing more than the verruga’s invasion, which would soon be followed by the period of nodular eruption, at which point the other troubles would abate.

His friends thought otherwise. They were impressed by the rapid progress of anemia, which dominated Carrión’s symptoms from this point onward. More generally, they noted a light and rapid pulse, a heart murmur that became progressively more pronounced, pains of varying severity, periodic cramps, prostration, dizziness, poor appetite, loose and fetid stools, sensitivity to light and noise, marked insomnia, restlessness, and intense general discomfort.

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11M.G. Schultz, p.1324.
By 2 October fasciculations had appeared in his arm muscles; his lips and skin were ashen; he could no longer keep his head upright; his eyes were vacant; and all of his usual vivacity was gone. Even so, he was still thinking clearly enough to correctly diagnose his deadly ailment. That morning he told his friends:

Up to today, I thought I was only in the invasive stage of the verruga as a consequence of my inoculation, that is, in the period of anemia that precedes the eruption. But now I am deeply convinced that I am suffering from the fever that killed our friend Orihuela. Therefore, this is the evident proof that Oroya fever and the verruga have the same origin, as Dr. Alacro once said.12

This realization was bad news. Unlike verruga peruana, which killed few people directly, Oroya fever commonly slew 40% of its adult victims. Lurking in the Peruvian highlands, it first came to light dramatically in 1870 when it slaughtered Meiggs’ railway workers. Typically, Oroya fever caused symptoms like those Carrion had experienced—bone, joint, and muscle pains, fever with rapid pulse, jaundice, and one of the most severe and rapidly developing of all human anemias that evolved as Bartonella bacilliformis attacked red blood cells and the sick person’s immune system removed infected cells.

Years later, research showed that the B. bacilliformis bacteria causing both verruga peruana and Oroya fever tend to infect many residents of endemic zones in childhood, producing relatively mild symptoms, and these childhood infections induce enough long-lasting immunity to prevent future infections from doing serious harm. As a result, immune residents and asymptomatic carriers, as well as people experiencing Oroya fever and verruga peruana, exist side by side in endemic zones. Of course, the people who stand out are those with the verrugas—which emerge late in the course of the disease, after most of the B. bacilliformis have been eliminated, when vascular and other tissues proliferate where pockets of offending bacteria remain.13

Some connection between Oroya fever and verruga peruana had been suspected, because many survivors of the great Oroya fever epidemic of 1870 later developed verrugas; but it was Carrión who showed not only that verruga peruana can be transmitted, but also that it and Oroya fever have the same cause.

After Carrión made this deduction, little time remained. The next day a Dr. Flores saw him and examined his blood with one of the country’s few microscopes. He found Carrión’s red blood cells deformed, distended, and scanty, with less than two-fifths of the normal number present. He urged that the patient be transferred from his rooming house to a more hygienic setting.

Carrión agreed, because a blood transfusion could be performed in a hospital, and he now believed—in hindsight quite correctly14—that a transfusion was his only hope. However, after he was transferred to an institution known as the Hospital Frances on 4 October and all was in readiness for the transfusion, the physicians in charge unaccountably decided to delay the procedure. The following evening, after uttering the words “Enrique c’est fini,” Carrión died.

In contrast to his inoculation, which

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12Cuerpo Médico del Instituto Sanitas, La verruga peruana y Daniel A. Carrión, as translated in M.G. Schultz, p. 1325.

13It has been suggested that the verrugas are developed by the body in order to eliminate Bartonella during the tissue phase of the disease. See S. Re cavaren, pp. 461–70.

14See W.E. Ricketts, p. 779.
was almost completely ignored, Carrión’s death caused a mighty stir. All of Lima’s daily newspapers carried accounts, mostly laudatory, of his act. José Casimiro Ulloa, the most influential Peruvian physician of the day, wrote about Carrión’s self-experimentation and its results at length. Considerable debate emerged regarding the wisdom and legality of the inoculation performed on Carrión by Dr. Chávez. The Secretary of the University Medical Faculty publicly demanded an investigation. The police conducted an autopsy with astonishing ineptness. Carrión’s friends, joined by physicians at odds with leaders of the Medical Faculty, ridiculed these proceedings and praised Carrión’s sacrifice. The charges against Chávez were dropped. Carrión’s name was irrevocably tied to both forms of what became known as “Carrión’s disease.” And Carrión himself, who was quickly elected to posthumous membership in two key medical associations—the Peruvian Academy of Medicine and the Unión Fernandina—emerged from the fray as the leading martyr of Peruvian medicine.

In hindsight, the keenness of the excitement seems to have been out of proportion to its cause. Indeed, much of it appears to have been generated not by Carrión’s experiment but by an ongoing power struggle between contending factions of the medical fraternity, a struggle in which Carrión’s death became an issue.

Even so, the charge of criminality regarding Carrión’s inoculation was ill-founded. While the inoculation certainly proved disastrous for its protagonist, it should be noted that experimental inoculations of this sort were far commoner in those times than in ours. Today established research procedures, official regulations, extensive use of human volunteers, available animal models, and the practice of group rather than individual research has made experimental inoculation of researchers and their colleagues very rare.

But a century ago the emphasis was on individual discovery, and there were relatively few rules, volunteers, or laboratory animals around. So numerous investigators exposed themselves to a host of ills. The celebrated Robert Koch fatally inoculated another physician with blood from a cholera patient. A number of other researchers died of self-inoculated cholera. As recently as 1900 two U.S. yellow fever researchers in Cuba, Jesse Lazear and James Carroll, sought the bites of infected yellow fever mosquitoes. And a long list of others, including some who were roundly praised for their valor, inoculated themselves or colleagues with dangerous materials linked to diseases as varied as osteomyelitis and syphilis.

Compared to all this, Carrión’s act was relatively mild. In the event verruga peruana proved transmissible, he expected no more than pain, illness, and temporary disfigurement followed by recovery. Though he had reflected upon death as a far-fetched possibility, neither he nor his friends appear to have put much store in the verrugas’ possible link with Oroya fever, and Carrión clearly did not expect to die.

Perhaps one reason why Carrión’s memory has remained alive in Peru and elsewhere was his motive. Despite his limited means, he was seeking a real answer to a disagreeable ill of his homeland, and he was willing to make a real personal sacrifice to get it. So to some extent his experience has come to symbolize all sacrifices by health workers for the public good.

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15Founded by a group of medical students at the San Fernando Medical School in 1883, the Unión Fernandina soon came to play a key role in Peruvian medicine. However, there is no evidence that Daniel Carrión belonged to this organization before being admitted posthumously in 1885.
Of course, he got more than he bargained for. But besides that, and besides tragically demonstrating the perils of experimentation on oneself, his work was important. He did not find out how to diagnose verruga peruana early, nor did he discover a good preventive measure or a cure. But he proved verruga peruana could be transmitted; he demonstrated its tie to Oroya fever; and so he took the first key steps in a long quest for the human knowledge needed to effectively combat the disease that bears his name.

BIBLIOGRAPHY


Documentos oficiales relativos a Daniel A. Carrión. La Crónica Médica (Lima). 1885;2:401–08.


