Carlos Chagas, Health Pioneer of the Brazilian Backlands

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Carlos Chagas, the Brazilian physician who discovered American trypanosomiasis early in this century, was unusual—unusually gifted, unusually educated, unusually hard-working, and unusually familiar with Brazil's rural lifestyles and rural folk. He was also a keen observer and careful scientist. So he might almost have been expected to find some little-known or unknown disease lurking in the Brazilian backlands.

What he found, however, was no minor ailment but the great occult affliction of the Americas. Now known as Chagas' disease, it is common, wide-ranging, tenacious, and sometimes fatal. Extending from the southern United States (where it is very rare) to Argentina, it infects roughly 8 million people and threatens perhaps 40 million others. And though it seems to kill less than 10% of its victims outright during its first onslaught, it can remain with survivors for decades, producing effects that range from mild undetected disturbances to heart failure and sudden death.

Before 1909 these facts were not known because the disease was well hidden. It mimicked other ailments. It defied the routine diagnostic methods of the day. It visited overt symptoms mostly on infants and young children. And it concentrated its attentions on poor rural people beyond the pale of health care and medical research.

Therefore, it is not really surprising that this malady was unknown in 1909, or that many eminent physicians remained skeptical of its existence long after its discovery. The really surprising thing is that Carlos Chagas, while working under extremely primitive conditions at the age of 29, succeeded single-handedly in stripping away all the masks from the disease that bears his name.

CHAGAS' EARLY YEARS

Carlos Justiniano Ribeiro Chagas, the eldest of four children, was born on 9 July 1879 in Brazilian coffee-growing country. He hardly knew his father, because the latter died when Carlos was only four years old. So his upbringing was overseen by his mother Mariana, who like her son was quite remarkable.

Born Mariana Ribeiro de Castro, she
grew up on a large coffee farm owned by her father in Oliveira, a rural town about 170 miles northwest of Rio de Janeiro. The eldest daughter in a family of 12 children, she learned responsibility early. She also married young, while in her teens; and in due course she and her husband, Jose Justiniano das Chagas de Andrade, bought a coffee farm in a town called Juiz de Fora, roughly halfway between Oliveira and Rio, and settled there.

Soon after that Jose died, leaving Mariana a widow at age 24 with four small children. She thereupon decided—against both the traditions of the day and her father’s counsel—to continue managing the farm herself. This decision stuck, and Mariana ran the farm successfully during all the years when Carlos was growing up. She also remained close to her family, with the result that she and her children spent roughly half their time in Juiz de Fora and the rest in Oliveira.

In 1886, when Carlos was seven years old, his mother sent him to a Jesuit boarding school in the neighboring state of São Paulo. He did not stay long, however, because outside events intervened. Slavery was legal in Brazil then, and farmers like Mariana Chagas depended upon slaves to work their fields. Therefore, when Brazil’s last monarch, Emperor Dom Pedro II, abolished slavery in 1888, the act created a rash of wild rumors and grave uncertainty among the coffee-growers.

Alarmed by all this, young Carlos decided to head home. So he persuaded a friend to join him, and the two ran away from school. They were caught in a mere four hours, but their adventure led Mariana to transfer Carlos to San Antonio, another religious school closer to home, where he received inspired instruction and established a reputation for studiousness and dedication to intellectual pursuits.

By the time he graduated from San Antonio, Carlos Chagas had decided to become a mining engineer; and so he began attending the prestigious School of Mines at Ouro Prêto. His plans soon changed, however. In 1895, not long after entering Ouro Prêto, he was struck by an illness diagnosed as beri-beri and withdrew to Oliveira to recover. There he encountered one of his uncles, Carlos Ribeiro de Castro. The uncle, a respected physician and man of letters, was practicing medicine in Rio de Janeiro, where he had established a clinic employing Lister’s antiseptic methods. He urged his nephew to switch from engineering to medicine; and whether by dint of his own persuasive powers or Chagas’ uncertainties about an engineering career, he succeeded. Carlos thereupon abandoned engineering, left Ouro Prêto, and in 1896 entered Rio de Janeiro’s School of Medicine.

PUBLIC HEALTH

At that time, when all of Brazil had only 10 million people, Rio de Janeiro was a small port beset by many ills. Yellow fever was rife, as were smallpox, bubonic plague, and other scourges. European vessels refused to dock there for this reason; and while immigrants tended to be especially vulnerable, native populations were periodically so devastated as to prohibit major progress.

While doubtless impressed by these problems, Carlos Chagas had little time to explore either the virtues of the city or its troubles in ways unrelated to his studies. His secondary school training had taken hold, and he was consumed by a desire to learn. Even among his generally studious medical classmates he stood out. Indeed, at a time before the Rio de Janeiro School of Medicine had electric light, when a student’s dedication was gauged by the fraction of a candle he
burned each evening, Carlos Chagas was known as a two-candle student.

This dedication, combined with obvious ability, soon attracted the attention of fine teachers. One of his mentors, Miguel Couto, the father of modern clinical medicine in Brazil, brought him to the home of an uncle, Fernando Lobo; and in this way Carlos was introduced to Fernando’s daughter Iris whom he eventually married. Another mentor, Francisco Fajardo, made him his assistant and insisted that he receive instruction in work against malaria, whose mosquito vector had just been revealed by Ronald Ross. This latter instruction, combined with other studies, placed Chagas at the cutting edge of public health work against malaria and other vector-borne disease.

When the time came for him to write a thesis, Fajardo proposed that he do a hematologic study of malaria and pro-
vided him with a letter of introduction to the director and founder of Rio de Janeiro's Manguinhos Institute, Oswaldo Cruz. At this time (1902) Oswaldo Cruz was not yet the giant of Brazilian medicine that he would soon become. The mosquito theory of yellow fever had only been proved in 1901 through banishment of yellow fever from the Cuban capital of Havana; and Cruz, a mere seven years older than Chagas, was just beginning the task of ridding Brazil's ports of yellow fever by systematically combatting its mosquito vector, *Aedes aegypti*, and isolating yellow fever patients. He was also spearheading campaigns against smallpox and plague by introducing mass vaccination, and was in the process of transforming the diminutive Manguinhos (later renamed the Oswaldo Cruz Institute) from a place mainly concerned with sera and vaccine production into one of the world's most dynamic centers of experimental and preventive medicine.

Chagas and Cruz got on well, and indeed became lifelong friends. Nevertheless, Chagas may initially have been intimidated; for upon completing his thesis he turned down an invitation from Cruz to join Manguinhos and instead accepted a minor post at a rural hospital in a town named Jurujuba, where he opened a private practice.

This venture proved short-lived. Chagas soon saw he would be unable to support his family—then consisting of his wife Iris and the first of their two sons. So when Fernando Fajardo presented him with a job offer from the Santos Docks Company in 1905, he accepted. The company, charged with building port facilities at Santos to serve the city of São Paulo some 30 miles inland, was finding its work seriously impeded by malaria, and Chagas was hired to fight the ailment.

As Fajardo knew, Chagas was ready. Convinced that most malaria cases were transmitted domestically, he focused his Santos work on the need to destroy the anopheline mosquito vectors inside houses. This key idea, which underlay the worldwide campaign against malaria half a century later, could not be pursued ideally in Chagas' day because effective, cheap, and long-lasting insecticides were lacking. Even so, the youthful Chagas managed to carry out the first successful antimalarial campaign in Brazil—a striking success that enabled the Santos Docks Company to complete its project, enabled Santos to effectively serve São Paulo as a port, and ultimately paved the way for Santos' speedy transformation into Brazil's busiest harbor.

Not surprisingly, Chagas soon found his services in demand elsewhere. His next job was to deal with malaria along the Xarem River on the outskirts of Rio de Janeiro, where the disease was blocking a key dam-building project. Here again he met with spectacular success. Thus reinforced by achievement, in 1906 he joined Manguinhos, with which he remained affiliated the rest of his life.

**WORK IN THE HINTERLANDS**

Around this time the Brazilian Government was trying to extend its Central Railway to connect Belém, at the mouth of the Amazon River, with Rio de Janeiro to the south. Construction had proceeded apace through the Minas Gerais hinterlands, but in 1907 a severe malaria epidemic among railway workers in the Velhas River Valley forced a halt. Responding to this outbreak, the government minister in charge asked Oswaldo Cruz for help. Cruz immediately dispatched Carlos Chagas and an assistant, Belisario Penna, to the scene, where they wasted no time creating a modest headquarters near the stalled works at a small town called Lassance.
Lassance was primitive. One of Carlos Chagas' sons, who described the place years later, said most of those not working for the railroad were small farmers or simple merchants. The most important man in town was the pharmacist. The town center had one main street that paralleled the railroad and was lined with generally closed town houses belonging to owners of distant farms. Two lesser thoroughfares, the "Street of the Knife" and the "Street of the Shot" harbored dives and houses of ill repute catering to herders driving cattle to market, who would pasture the beasts outside Lassance and come into town looking for excitement. Then, like their U.S. counterparts in the Old West a half-century before, these cowboys would shatter the peace of Lassance with brawls and periodic mayhem.3

Obviously, in these years well before the automotive age and good roads, Lassance was poorly fixed to support long-term medical research. However, Carlos Chagas was well-connected with the most advanced frontier institution present—the railroad. So rather than seek local accommodations, he set up living quarters in a boxcar, equipped it to double as his consultation room and laboratory, made a nearby shack along the rail line into his surgery, and went to work.

Despite this arrangement's shortcomings, Chagas soon beat back the malaria epidemic, and construction of the line resumed. But this was not a one-shot campaign like those at Santos and the Xarem River Dam. The new line had far to go, and it was important to scout out potential malaria problems ahead. So Chagas and Penna spent over a year making forays from their Lassance headquarters to assess problems along the proposed line—during which time they saw numerous disease cases in malarious areas as well as in malaria-free zones.

To their surprise, they found significant numbers of these cases defied diagnosis by any of the available clinical or laboratory methods. And while many local problems—caused by such things as nutritional deficiencies, helminthic anemias, and goiter—probably differed from what Chagas had commonly seen in the wards and consultation rooms of Rio, he nevertheless felt that the unexplained cases presented a puzzle needing to be solved.

**DISCOVERY**

One evening, while Chagas and Penna were spending the night at an engineers' camp on the way to a place called Pirapora, the chief engineer showed them a blood-sucking bug that infested local dwellings. Known to area residents as the barbeiro ("barber") for its attacks on the face, and to entomologists as Panstrongylus megistus,4 the bug would typically hide in roof thatch or wall cracks by day, and soon after dark would emerge to extract blood from unconscious sleepers.

Chagas, of course, was primed with humanity's new knowledge of blood-sucking disease vectors and disease transmission cycles; and that, together with the puzzling local disease cases, struck a spark. As he later explained, "Once we had heard of the blood-sucking habits of this insect and of its proliferation in human dwelling-places, we became very interested in knowing its exact biology and above all in ascertaining if by any chance it were . . . a trans-

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4This particular vector, one of many triatomid bugs that transmit Chagas' disease, was formerly known as *Conorhinus megistus* and *Triatoma megista*.
mitter of any parasite of man or of another vertebrate.\textsuperscript{5}

He therefore procured more specimens of the bug to examine their digestive tracts and salivary glands—places likely to harbor disease agents. His ensuing dissection and examination revealed numerous flagellates in the posterior intestines of all of the bugs observed.

Chagas had previously found a new species of trypanosome (\textit{Trypanosoma minasense}) in local marmosets; and since the flagellates found in the barbeiro could well have represented another stage in the life-cycle of this trypanosome, he decided to see if the bugs could transmit their flagellates to uninfected marmosets. Unfortunately, virtually all the local mar-

mosets appeared to be infected already; and so Chagas sent specimens of the barbeiros to Oswaldo Cruz at Manguinhos, where marmosets of the species Callithrix penicillata were bitten by the bugs or injected with their intestinal contents.

When the first of these infected marmosets died a few weeks later, Oswaldo Cruz called Chagas back to Manguinhos. According to Chagas' own account, upon arriving "I examined the blood of one of these monkeys . . . and found in it a trypanosome, which at first sight and before examining it by technical methods I took to be Trypanosoma minasense. After having seen the flagellate alive, between cover-glass and slide, I made some fixed and stained preparations in which it was seen to show characters entirely distinct from those of Trypanosoma minasense and to show no similarity to any other trypanosome. It was undoubtedly a new species whose chief [distinguishing] character lay in its blepharoplast, the biggest I had yet seen and located at the hind end (the end opposed to the free flagellum)." 

Confronted with this previously unknown parasite, Chagas sought more knowledge. Among other things, while at Manguinhos he carefully determined its form at each stage of its complex double life-cycle and succeeded in culturing it artificially in laboratory media. He also found that it could be transmitted not only to monkeys but also to puppies, guinea-pigs, and rabbits, and that it was pathogenic for these creatures, generally causing death from septicemia. Armed with this information, he proceeded to name the microbe Trypanosoma cruzi after Oswaldo Cruz and returned to Lassance with the specific aim of finding the parasite's principal vertebrate host.

The existence of unexplained human disease cases, together with the bug vector's preference for human dwellings and human blood, made it seem likely that the principal vertebrate host was man. Nevertheless, Chagas' initial efforts to find T. cruzi in the blood of local residents with unexplained disease symptoms were unsuccessful—presumably because nearly all the parasites disappear from the bloodstream once the relatively short acute phase of the disease has passed.

However, Chagas did manage to find T. cruzi in the blood of a sick cat at one barbeiro-plagued home; and later, as he explained, "I chanced to find in a feverish condition a child from the house in which I had found the infected cat. Now, a fortnight or 20 days before, I had spent a night in the house and had seen a great number of insects stinging the dwellers including the little girl who now lay feverish and who at the time had been in perfect health."

"Among the chief clinical symptoms of this child, whose fever had come on some eight or 10 days before examination, were the following: Axillary temperature 40°C; spleen enlarged and to be felt under the edge of the ribs; liver also enlarged; groups of peripheric lymphatic glands swollen, etc. Most noticeable was a generalized infiltration, more pronounced in the face, and which did not show the characters of renal edema but rather of myxedema [a dry, waxy type of swelling commonly associated with hypothyroidism]. . . .

"Examination between cover-glass and slide revealed the existence of flagellates, in good number; and the fixing and staining of blood-films made it possible to characterize the parasite's morphology and to identify it with Trypanosoma cruzi. . . . Thus was proved the existence of a new trypanosomiasis of man."

6See note 5 above.

7See note 5 above, p. 7.
Chagas first found trypanosomes in the blood of the little girl, named Berenice, on 14 April 1909. He reported the results immediately in a note to Oswaldo Cruz, and eight days later Cruz announced the discovery at a session of Brazil's National Academy of Medicine. Cruz also assembled a singular group—including some of Brazil's most distinguished physicians—and made a pilgrimage with them to Lassance.

One member of this party was Miguel Couto, Chagas' former teacher. As he related, "Carlos Chagas was waiting for us with his museum of rarities—several dozen patients of all ages, some idiots, others paralytics, others heart cases, thyroids, myxedemics, and asthenics. Microscopes were scattered all over the tables showing trypanosomes in movement, or pathological anatomic lesions. In the cages were animals experimentally infected and jars full of triatomines in all stages of development. The passage of years has not dimmed my memory, and I am sure neither that of my colleagues, as to the formidable impression of this unheard of spectacle.

"Every item of this demonstration was carefully examined by us. The doctors gathered there, undisputed authorities in their field . . . had nothing to deny or add to the analysis of the symptoms or their interpretations. . . . It was a definitive work, to which time would infallibly add, but without marring the original pattern."

This gathering provided a fitting climax to what was in fact a dazzling feat of medical research. Most vector-borne diseases have been discovered in afflicted patients by one or more physicians, who have thereby paved the way for other workers to reveal first the disease agent and then the vector. Chagas, in effect, started backward—by first identifying the vector, then finding the agent, and then linking the agent to a disease. Even more remarkable, he did the whole job himself with only minor help from others—one of very few times in medical annals, if not the only time, when a major disease has been identified this way.

That point was not lost upon Couto, who was assigned the honor of naming the disease. According to him, "On that day it was up to me to give a name to those traditional diseases of the Minas [Minas Gerais] backlands, which were now unified as one disease with cause and development clearly established. To name it after only one of its symptoms would be to limit its description, and to name it for all its symptoms would be impossible. . . . And so, at dinner, while toasting Carlos Chagas, I . . . chosen because of my age, standing with Oswaldo Cruz on my right and surrounded by the men most representative of Brazilian medicine of that era, with a gravity equal to a liturgical act in our religion, such as a baptism, gave the name of Chagas' Disease to that illness . . . in the name of the entire delegation."

The professional and lay response to these developments was strong. Chagas was soon elected to membership in Brazil's National Academy of Medicine as well as several other Brazilian medical societies, and the Brazilian press gave the news of his discovery good coverage. International interest was also keen. Among other things, Chagas was made a corresponding member of the Exotic Pathology Society of Paris. Willem Hoffman, a student of Robert Koch's who had been working with Carlos Finlay in Cuba, made a special detour to visit Chagas on his way back to Berlin. In 1910,
when Max Hartmann returned to Germany from a visit to Brazil ready to deliver a briefing on the new disease, Koch himself held a special meeting at his home to receive it. And in 1912 Chagas won the Schaudinn Prize awarded every four years for the best work in parasitology and tropical medicine in the world.

FOLLOW-UP

Chagas himself devoted much of the years 1909-1911 to confirming his findings and investigating chronic forms of the disease. His first great detailed report, “New Human Trypanosomiasis,” appeared in the Memórias do Instituto Oswaldo Cruz in 1909, where (like all that journal’s articles) it was published simultaneously in German and Portuguese. Here Chagas described the acute phase of the disease; the transmission and virulence of \textit{T. cruzi}; and the development and morphology of \textit{T. cruzi} in artificial media, the insect vector, laboratory animals, and man.

He did not describe the chronic disease, because its existence had not yet been confirmed. But as he later noted, “my clinical experience and knowledge of the unusual condition of local inhabitants led me to admit that in this trypanosomiasis, besides the acute form, other chronic ones awaited detection and description.”

So around the time his first report was published he began to seriously investigate those chronic forms.

Among the symptoms that had most impressed him were extremely common alterations of the heartbeat in local residents, especially those living in triatoma-infested houses—alterations that gener-

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\textsuperscript{10}See note 5 above, p. 7.
ally took the form of extrasystoles, often with slow pulse. Since many of the affected subjects commonly exhibited enlarged thyroid glands, Chagas first ascribed the heart alterations to goiter. However, he soon found patients with heart arrhythmias who showed no signs of goiter.

One day he performed an autopsy on a child whom he had previously diagnosed as having the acute form of the disease. The resulting autopsy specimens were sent to Manguinhos, where they were examined by Gaspar Vianna, a noted expert in pathological anatomy. Vianna found curious parasitic forms contained in actual cysts within the child’s myocardium; and Vianna’s conclusion that these were probably special forms of *T. cruzi* gave Oswald0 Cruz reason to visit Chagas in Lassance, bringing with him slides and smears of the infected tissue.

Upon examining these samples, Chagas recognized forms of *T. cruzi* identical to those he had seen when the parasite was cultured on artificial media. As he later recalled, “No doubt remained, therefore, as to Vianna’s observations of the localization of the trypanosome. This furnished the acceptable interpretation to one of the most frequent clinical symptoms of the disease, disturbance of the rhythm of the heart.”

Chagas did not stop there. He also pointed to the armadillo as a wild reservoir of *T. cruzi*, associated the chronic ailment with heart enlargement and a variety of glandular and nervous disorders, and published a definitive account of the disease in its chronic phase.

He did not discern everything. He did not realize that *T. cruzi* was carried by more than sixty triatomid bug species, or that many of the severe chronic symptoms were caused by damage to nerves serving affected organs, or that gross enlargement of the colon and esophagus were among the more common chronic problems. But he learned enough to know that the chronic as well as the acute problems were serious, and to provide the best descriptions of the disease, parasite, and vector available anywhere for over 20 years.

His work on the chronic forms, “Nova Entidade Mórbida do Homem” (“New Morbid Entity of Man”) appeared, together with an article and drawings by Vianna, in 1911. Soon after that, in 1912, Oswaldo Cruz asked Chagas to perform an assessment of health conditions in the Amazon Basin for the Government. Pursuing this mission, he spent two years exploring the rain forest on barges and riverboats, and almost inevitably contracted malaria himself. This odyssey yielded “Epidemiologia no Vale do Amazonas” (“Epidemiology in the Amazon Basin”), coauthored by himself and Oswaldo Cruz in 1913, together with a wealth of experiences reinforcing his already strong belief that public health work in the hinterlands was badly needed.

**LATER EVENTS**

He soon had ample opportunity to put that belief to work. In 1917 Oswaldo Cruz died and Carlos Chagas was named to replace him as the Director of Manguinhos, a post he held until his own death in 1934.

Beyond that, in 1921 the Government accepted Chagas’ recommendation to create a National Department of Public Health and made him the new agency’s director.

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From then until 1926 he oversaw wide-ranging national actions—including creation of rural disease prevention services, training of public health physicians, and establishment of inspectors charged with combating tuberculosis, syphilis, infant health ailments, and other troubles. Overall, he ably continued the public health campaigns begun by Cruz and made a creditable start on the enormous job of serving rural needs.

This combination of pioneering research and effective public health leadership had great appeal at home and abroad—with the result that Chagas was showered with awards: the Grand Prize of the Pasteur Centenary Commemorative Exposition; honorary degrees from the universities of Buenos Aires, Lima, Harvard, Brussels, Hamburg, and Paris; and membership or honorary membership in over a dozen medical societies around the world.

Ironically, however, once deprived of his direct attention, work against the disease he had discovered fell upon hard times. Starting around 1915, critics led by the German microbiologist R. Krause said they could not find cases of Chagas’ disease in areas such as the Argentine Chaco that had plentiful populations of T. cruzi-infected triatomid bugs. Others, inside Brazil and elsewhere, soon raised similar doubts about whether the disease mattered, whether it even existed, and whether the reported symptoms were being caused by other ills. Indeed, skepticism became so widespread that despite periodic rebuttals by Chagas and various workers at the Oswaldo Cruz Institute, from 1920 onward his concept of the disease and its etiology appeared outmoded; and while Chagas himself remained respected, those who espoused his view of the disease were generally ignored.

All this is understandable because detecting the disease was tricky. The acute phase was often asymptomatic. Observable numbers of T. cruzi only appeared in the blood of human victims for 30 days or so, and even then the numbers were rather small. Also, most victims in endemic regions experienced the acute phase as infants or young children, making it easy for many cases to escape notice.

Furthermore, most of the overt acute symptoms could be produced by other causes. The fever and the swollen lymph glands, spleens, and livers of people with acute Chagas’ disease could be attributed to malaria or other ailments, while their characteristic edema was commonly attributed to goiter. Likewise, any number of things could account for edema of the eyelid (Romani’s sign) seen in some acute cases, as well as for the lingering inflammation (chagoma) at the site of the infecting bite.

Worse yet, diagnosis of the chronic phase made diagnosis of the acute phase seem a lark. To all superficial appearances, no trypanosomes were present in the blood. Cardiac arrhythmias, heart failure, a wide range of nervous system disorders, and edema—the principal symptoms pointed out by Chagas—were all familiar medical problems in rural Brazil requiring no new explanation. And even if occasional careful autopsies revealed parasites in heart and other tissues, the connection between those parasites and the patient’s demise was uncertain.

Beyond that, even Chagas agreed that failure to detect disease cases in T. cruzi-infested areas could be due to variations in T. cruzi strains. So there was room to argue that the places where the disease was doing harm were limited to a few rural areas, or even to the single rural area around Lassance—an argument

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Carlos Chagas at Manguinhos.
Above: Chagas in his Manguinhos laboratory. Below: Manguinhos staff members and friend. Carlos Chagas (center) stands next to Albert Einstein, who was one of the Institute's many distinguished visitors. (Photographs courtesy of Fundação Oswaldo Cruz.)
strongly if unfairly reinforced by most
potential victims' ignorance, obscurity,
poverty, illiteracy, lack of medical atten-
tion, and lack of political or economic
clout.

Chagas himself confronted this tide of
misguided opinion many times before his
death in 1934. Besides speaking on the
subject at numerous scientific meetings,
in the early 1920s he wrote a series of
articles for influential journals in Brazil,
Argentina, and the United States clearly
linking T. cruzi with severe or fatal illness
and pointing out places where leading
critics had gone wrong. But by then the
opposing tide was running too strongly
for him to turn it back. So that is pretty
much where matters lay on 8 November
1934 when Carlos Chagas died suddenly
while working at his desk, apparently of
heart failure. He was then 55 years old.

Ironically, around that time new evi-
dence began emerging. Electrocardiogra-
phy, the first good tool for exploring the
disease's epidemiology, became avail-
able. In 1934 Salvador Mazza reported
finding numerous Chagas' disease cases
in the Argentine Chaco—precisely where
Krause had failed to find them.¹⁵ Mazza's
revival of Chagas' views was strongly
seconded by others. And starting in the
1940s, new immunodiagnostic methods
revealed that Chagas' disease did not just
exist but thrived, that it was widespread
in the Americas, and that it afflicted hu-
manity on a hitherto unsuspected scale.

By the late 1960s, extensive public
health work had revealed an overall pic-
ture similar to the one we recognize to-
to-day. As a WHO report of 1969 explained
to its readers, 'The prevalence of Cha-
gas' disease, particularly in South Amer-
ica, is far greater than was formerly sup-
posed, and it has been estimated that up
to seven million people may harbor Try-

¹⁵S. Mazza, Casos agudos benignos de enfermedad
de Chagas comprobados en la provincia de Jujuy.
MEPRA 17:3–11, 1934.

panosoma cruzi infections. Although the
mortality resulting from the acute form of
the disease may be less than 10%, the
long-term social and economic effects of
the chronic states are incalculable. Fur-
thermore, the distribution of the arthro-
pod vectors and the occurrence of T. cruzi
in animals are more widespread through-
out the Americas than is the extent of hu-
nan infection, presenting a further epi-
demiologic threat.'¹⁶

Since then, despite improved diagnos-
tic methods, we in the Americas have
gained relatively little ground. Indeed,
we have not come awfully far from the
point Carlos Chagas reached in 1909. We
now have insecticides that can eliminate
the vector bugs; we know certain home
construction methods to avoid; and we
have some drugs that can control the dis-
ease's acute phase. But insecticides and
drugs are costly; major campaigns have
shown that the effects of bug spraying
are temporary; traditional home-building
methods resist change; and most of the
children at risk of acute phase complica-
tions receive scant medical care or none
at all. So in practical terms, we know
what is happening on a grand scale but
feel powerless to stop it.

Nevertheless, the situation is not quite
so bad as it might seem. Medicine and
public health have made great strides
since 1909; and while the Chagas' disease
problem has proved intractable, we have
no reason to suppose that this intractabil-
ity is permanent. Eventually, the com-
bined work of many specialized research-
ers, improved public health services, and
progress in such fields as drug develop-
ment, insect control, and genetic engi-
neering should yield desirable results.

Meanwhile, we should recall that we
have a vast and growing store of diverse
public health information at hand that

¹⁶World Health Organization, Comparative Studies
of American and African Trypanosomiasis, WHO
could already contain some missing key. Indeed, it is conceivable that we are simply awaiting another remarkable individual, properly trained and situated, who can correctly combine certain diverse strands of information, much as Carlos Chagas did at his crude Lassance headquarters early in this century, when he was 29 years old and Chagas' disease was utterly unknown.

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