



Yellow fever epidemic in Philadelphia, 1793. Carriages rumbled through the streets to pick up the dying and the dead. Woodcut shows Stephen Girard on errand of mercy. © Bettmann/CORBIS.

Carlos Finlay, Walter Reed, and the politics of imperialism in early tropical medicine

Daniel Liebowitz

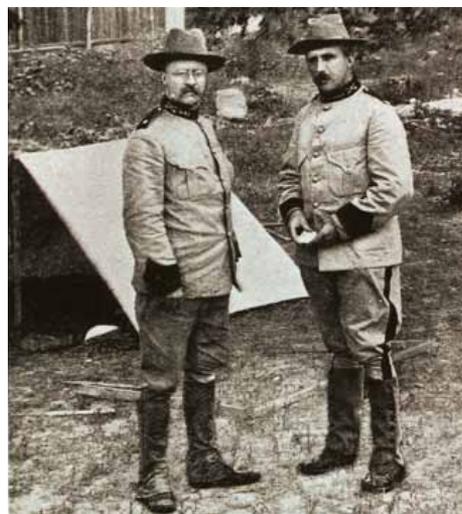
The author is a member of the Class of 2015 at the University of Vermont College of Medicine. This essay won honorable mention in the 2011 Helen H. Glaser Student Essay Competition.

On a warm September day in 1955, American and Cuban scientists and dignitaries convened in Philadelphia at Jefferson Medical College, the alma mater of Dr. Carlos Juan Finlay, to celebrate the centennial of Finlay's graduation from that institution. Finlay, who became a pioneer in the field of tropical medicine when he introduced the theory of mosquito transmission of yellow fever in 1881, might have been surprised by this bi-national recognition. At the time of his discovery, when nationalist spirits were strong and scientific views were often dictated by political climates, Finlay had been widely ridiculed or dismissed for his proposal of a theory that contradicted established scientific knowledge. What gave rise to this belated celebration of his life's work?

Finlay's research was largely ignored until the United States realized that it had a stake in Cuba and the rest of the mosquito-infested tropical world. In April 1898 the United States government declared war on Spain. The first U.S. soldiers landed on Cuba in June. The island was infamous for its deadly yellow fever climate, and the men who came to fight knew that they had two enemies: Spain and disease. In the July campaign at Santiago de Cuba, the United States defeated the Spanish, but not before yellow fever struck. In a letter to

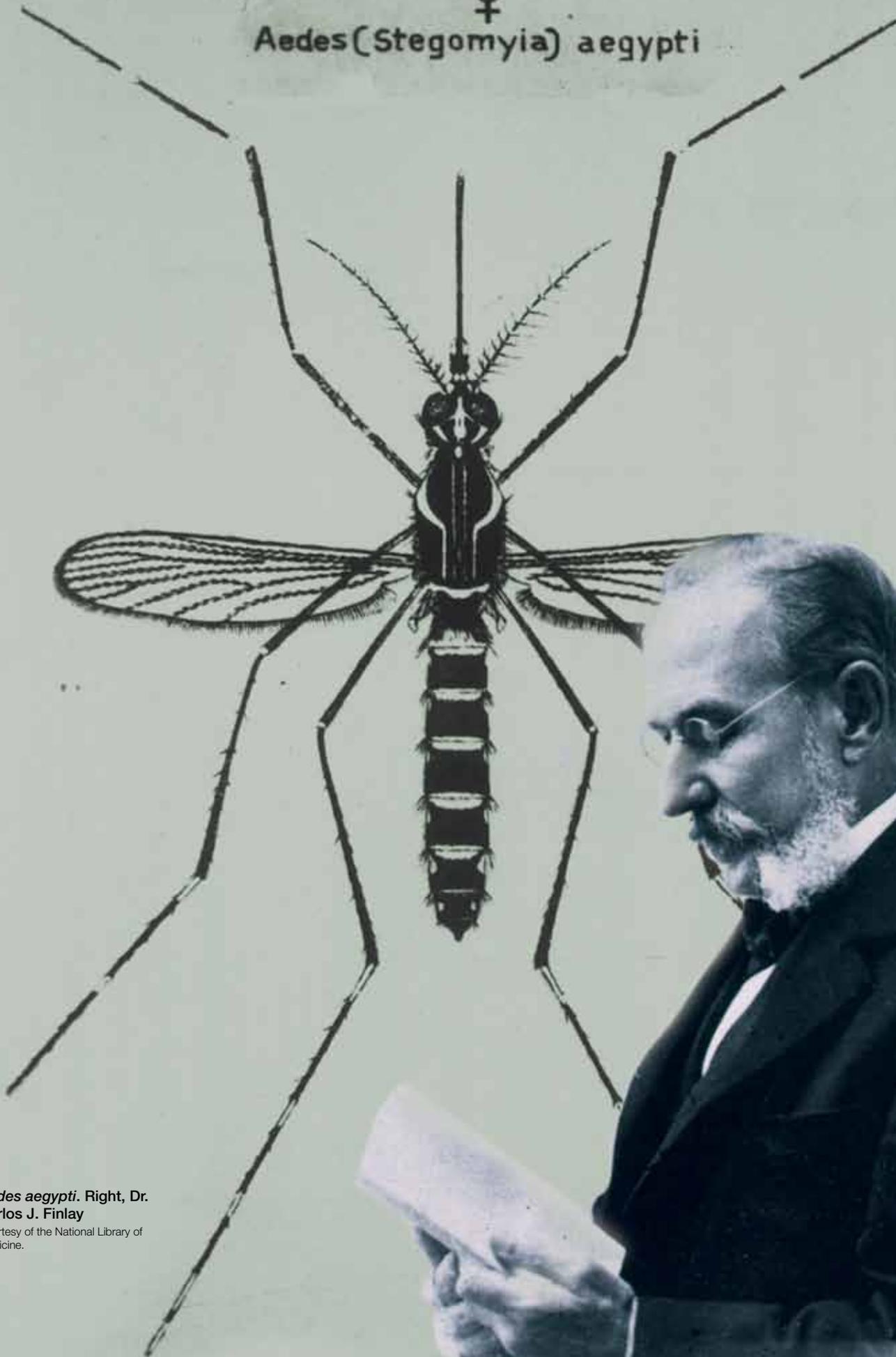
Major General William Shafter on August 3, 1898, Lieutenant Colonel Theodore Roosevelt wrote

There is no possible reason for not shipping practically the entire command North at once. . . . If we are kept here it will in all human possibility mean an appalling disaster, for the surgeons here estimate that over half the army, if kept here during the sickly season, will die.¹



Lieutenant Colonel Roosevelt and Colonel Leonard Wood. Courtesy of The National Library of Medicine.

♀
Aedes (Stegomyia) aegypti



Aedes aegypti. Right, Dr. Carlos J. Finlay

Courtesy of the National Library of Medicine.



The Prado in Havana in 1899. Courtesy of the Historical Collections & Services, Claude Moore Health Services Library, University of Virginia.

Roosevelt's plea came too late; nearly 2,000 men contracted yellow fever in that camp. The disease's devastation to the U.S. Army spurred the creation in June 1900 of the U.S. Army Yellow Fever Commission, presided over by Major Walter Reed. The Commission eventually was successful in confirming the theory of mosquito transmission of yellow fever and used this knowledge to eradicate the disease first from Havana and then from other newly acquired American territorial possessions. But the studies on yellow fever at the turn of the twentieth century were inseparably intertwined with the politics of nationalism and imperialism.

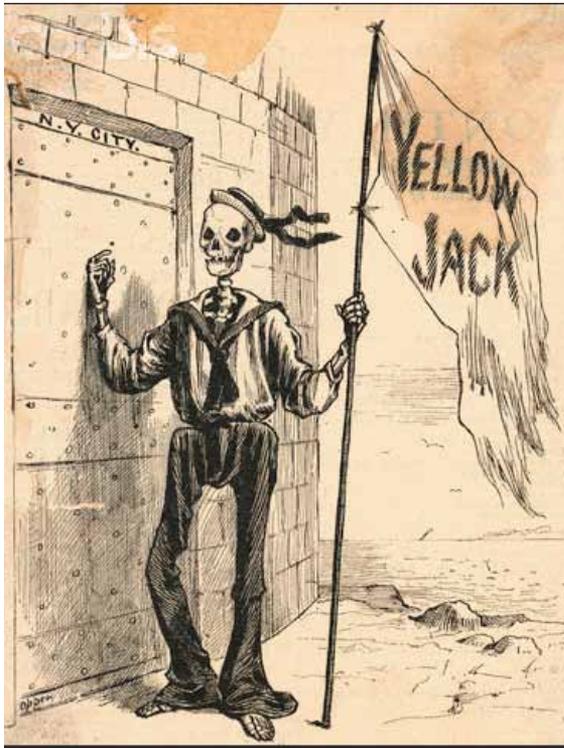
When Finlay began his research on yellow fever in the 1870s, very little was known about this mysterious disease. Endemic in Cuba, it caused great morbidity in the native-born infected in childhood and great mortality in immigrants who lacked immunity. In the United States, where the climate was cooler, yellow fever struck in waves of periodic epidemics. In 1878 a widespread epidemic hit more than 100 U.S. cities from the Deep South to as far north as Ohio. An estimated 120,000 cases of yellow fever and 20,000 deaths crippled commerce and had enormous financial costs. The disease struck people of all races, ages, and social backgrounds, and traditional efforts of quarantine and sanitation were fruitless. When the epidemic subsided as winter approached, the nation blamed the yellow fever epidemic on poor sanitation in the South and recommended isolating the epidemic states to punish them for their so-called "filthy living."^{2p60}

Despite the terror and devastation that the 1878 outbreak caused throughout the southern United States, after the epidemic subsided the U.S. government and public were largely satisfied to get on with business as usual and accept that periodic epidemics were a way of life. Lack of adequate funding in

the South, where yellow fever was most likely to strike again, and apathy from the rest of the country, where yellow fever was not a direct problem, meant scientific research on the disease gained very little support. The prevailing scientific theories on the contagion of infectious diseases attributed yellow fever to either miasma (a filth in the atmosphere) or fomites (disease-infected clothing and material). Americans were confident that sanitary reform that removed these sources of disease and isolated the sick from the healthy would stave off further epidemics or at least protect the wealthy and powerful from the sickly and "morally depraved" poor.^{2p61}

Unlike in the United States where yellow fever was an intermittent unwelcome visitor, in Cuba the disease was a constant presence. Most Cubans acquired the disease in childhood, leaving survivors with protective immunity. Yellow fever was less kind to foreign visitors or immigrants. As a Spanish colony, Cuba attracted many Spaniards both civilian and military. Yellow fever killed enough Spaniards to earn the nickname the "undaunted plague of foreign visitors" and the "greatest enemy of Spanish soldiers."^{3p78} It was in this disease climate that Carlos Finlay began his research.

Finlay, born in 1833 in Camagüey, Cuba, to a Scottish father and a French mother, completed his medical training in Philadelphia at Jefferson Medical College and returned to his native Cuba to practice and study yellow fever. He initially accepted the existing climate-miasma theory, which attributed the yellow fever climate in Cuba to chemicals in the air that created an alkaline atmosphere, but by the 1870s he began to notice compelling correlations between the prevalence of mosquitoes and the severity of yellow fever epidemics. In addition to making epidemiological and meteorological observations, he devised a method of inoculating humans



Political cartoon of 1878, "Shall We Let Him In? Mr. Mayor and gentlemen of the Board of Aldermen, the answer rests with you." © Bettman/CORBIS

with infected mosquitoes to test his theory. In 1881 he presented his first paper on the subject to the Royal Academy of Medical, Physical and Natural Sciences in Havana and the International Sanitary Conference in Washington, D.C., titled, "The Mosquito Hypothetically Considered as the Agent of Transmission of Yellow Fever." He began by stating

I feel convinced that any theory which attributes the origin and propagation of yellow fever to atmospheric influences, to miasmatic or meteorological conditions, to filth or to the neglect of general hygienic precautions, must be considered as utterly indefensible.^{4p27}

Finlay argued that

the meteorological conditions which are most favorable to the development of yellow fever are those which contribute to increase the number of mosquitoes.^{4p40}

At this early stage in his research he had only made five attempted inoculations, which had resulted in one mild case of yellow fever, two abortive cases in which yellow fever was not apparent but immunity seemed to result, and two cases of a nondescript, or as he called it, ephemeral fever. He concluded

These experiments are certainly favorable to my theory, but I do not wish to exaggerate their value in considering them final . . . I understand but too well that nothing less than an absolutely incontrovertible demonstration will be required



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before the generality of my colleagues accept a theory so entirely at variance with the ideas which have until now prevailed about yellow-fever.^{4p42}

He asked that his colleagues observe his epidemiological and experimental evidence and consider its merits. Since the existing theories had proven to be useless, the mosquito-transmission theory could lead to control of the disease.

From 1881 to the end of the century Finlay proceeded with his mosquito inoculation experiments, continuing to publish and present his mounting evidence of the correctness of his theory. Unfortunately, because his inoculations had limited success (of 90 individuals inoculated by 1894, he had only a few positive results), the scientific community in Cuba and abroad understandably continued to be skeptical. Despite shortcomings in his research, Finlay's astute observations on the habits of mosquitoes and the spatial and temporal distribution of yellow fever resulted in his identification of the sole carrier, the mosquito, and the primary species, *Culex fasciatus* (now called *Aedes aegypti*).

Finlay did not give up on supporting his theory, nor did he neglect to devise public health solutions based on his research. As early as 1898 he proposed practical methods to eradicate yellow fever that ultimately were used by the U.S. Army sanitarian Major William Crawford Gorgas after 1901. Finlay wrote,

Why should not the houses in yellow fever countries be provided with mosquito blinds, such as are used in the United States as a mere matter of comfort, whereas it might be a question of life or death? The mosquito larvae might be destroyed in swamps, pools, privies, sinks, street-sewers and other stagnant waters, where they are bred, by a methodical use of permanganate of potassium. . . . But the most essential point must be to prevent those insects from reaching yellow fever patients.^{5p354}

Finlay had, in the twenty years before the U.S. Army Yellow Fever Commission was established, observed or tested most of the “discoveries” the commission touted as its own. To understand the historical progression from the dismissal of Finlay’s work to U.S. Army scientists gaining world recognition for continuing what Finlay had started, it is important to trace the scientific and political interests of the United States in Cuba.

In 1881, when Finlay first proposed his theory, the concept of insect vectors of disease was still very new. In 1879 Patrick Manson of England observed that mosquitoes were the intermediate host of the filarial worm of the disease elephantiasis, but even then did not claim that disease could be passed directly from the mosquito to the human host. It was not until 1898 and Ronald Ross’s work on malaria that the theory of direct mosquito-human transmission began to be widely accepted.⁶

The political climate in Cuba and the country’s tenuous relationship with both Spain and the United States no doubt negatively affected Finlay’s research and his legitimacy. Social and political strife defined Cuban affairs, penetrating even to the disruption of academic and scientific research. After the unsuccessful bid for independence from Spain in the Ten Years War of 1868 to 1878, the Cuban economy and the value of sugar crashed together as Spain attempted to make Cuba pay for the war debt. Unemployment was high and large urban migrations led to dangerous overcrowding in the cities. Many white middle-class creoles like Finlay had their property confiscated and jobs replaced by the hundreds of thousands of Spanish immigrants who flooded into Cuba, seeking a better life in the New World. Many disgruntled creole Cubans became adamant supporters of separation from Spain and turned to the United States for both economic and political support. Cuban planters became increasingly reliant on the United States as U.S. capital penetrated deeper into the Cuban economy, and many even became advocates of U.S. intervention.⁷

As U.S. financial interests in Cuba grew and Spanish control over the island declined, the United States began to recognize that it needed to exercise more influence over the future of Cuba. The Second Cuban War of Independence of 1895 to 1898 offered the United States the chance to flex its imperial muscles. Debate within the United States between imperialists and anti-imperialists took many forms, but ultimately U.S. public officials and policy makers became convinced that the United States had a duty to protect its southern neighbors from Old World tyranny and to bring them into the modern world.

After the United States aided Cuban revolutionaries in ejecting the Spaniards, it established an occupation government to aid in Cuba’s transition to democracy. Under the military occupation government headed by General Leonard Wood from 1899 to 1902, the United States grappled with the fate of the island. Much of U.S. policy towards Cuba in the nineteenth century had been based on the presumed



Walter Reed. Courtesy of the National Library of Medicine.

inevitability of annexation. As early as 1823 John Quincy Adams suggested that it was only natural for Cuba to become a part of the United States because its connection to Spain was bound to fail and Cubans were inherently incapable of supporting the nation themselves.⁸ The majority of Cubans, however, were ardent believers in national sovereignty and complete independence. The opposition to annexation by Cuban nationalists made the nation a “burden and annoyance,” according to U.S. Secretary of War Elihu Root, but the United States was not about to relinquish all claims and leave its interests unsecured. Here the Platt Amendment loomed large. Attached as a rider to the Army Appropriations Act of 1901, the Platt Amendment limited Cuban independence with the aim of protecting U.S. interests and secured the right of the United States to intervene if the Cuban government proved incapable of maintaining stability and protecting property, including that owned by American citizens.⁷

Throughout the U.S. involvement in the Spanish-Cuban-American War and during the occupation period, U.S. interests were threatened by another more sinister enemy—the scourge of yellow fever. During the brief U.S. involvement in the war, more American soldiers died from yellow fever than from combat. The disease challenged U.S. strength and proved once again the powerlessness of U.S. medicine



Above, Reed (second from left) with volunteers and other at Camp Lazear, 1901. Right, Part of Camp Lazear, showing buildings 1 and 2.

Courtesy of the Historical Collections & Services, Claude Moore Health Services Library, University of Virginia.



against the mysterious fever. The Yellow Fever Commission under the leadership of Major Walter Reed was entrusted with the task of finding a cure and protecting American hegemony over Cuba.

The Commission began its research along the same lines as before, continuing to search for the causative microbial agent with no success. Aware of Ronald Ross's recent mosquito theory and an observation made by American scientist Henry Rose Carter on the incubation period of yellow fever, Reed and his men, with much hesitation and doubt, turned to Finlay for help. Finlay supplied the U.S. Commission with the eggs of *Aedes aegypti* that would prove once and for all that yellow fever was transmitted by the mosquito vector. Although the Commission was still convinced that the disease was most likely spread by fomites, they decided to test Finlay's theory. They isolated healthy individuals and exposed them to either mosquitoes (Building 2) or fomites (Building 1) that had been in contact with yellow fever patients and then observed whether or not the healthy subjects developed disease. It quickly became apparent that yellow fever was in fact spread by mosquitoes and not by fomites.⁹

With the theory supported, the U.S. Army mounted a

campaign led by Major William Crawford Gorgas to eradicate the disease by removing the mosquito vector. By drying up mosquito breeding grounds and destroying mosquito larvae in human dwellings, the Army Commission quickly eradicated yellow fever in Cuba, and Reed and Gorgas were celebrated as heroes and innovators in the realms of tropical medicine and public health. The supremacy of American medicine was secured and sanitary reform entered the rhetoric of American occupation. The Platt Amendment included a clause requiring the maintenance of the sanitation measures instituted by the U.S. Commission and prevention of epidemics of infectious diseases, a logical addition to the many other restrictions on Cuban independence.¹⁰

Considering the U.S. climate of animosity towards Cuban



Major General William Crawford Gorgas.
Courtesy of the National Library of Medicine.

resistance to American annexation, it is not surprising that Finlay's contribution to Reed's confirmatory experiments was largely diminished or entirely denied. In the process of turning over the rule of law to the Cuban government, Finlay was granted a leading role in the public health movement because of his closeness to the Americans, but this was much different from giving him credit for a theory that had such far-reaching consequences in global health and imperialism.

The credit for confirming the mosquito vector of yellow fever was hotly contested because of its symbolic power in a modernizing world. The American role in the discovery and eradication of the yellow fever vector served as justification for U.S. intervention and proved to the American public that it was a civilizer and bringer of modernity to the Cuban people. Cuban nationalists, upset by the American intervention that seemed to be a mere replacement of Spanish domination, saw Finlay's pivotal role in the American Commission's efforts as proof of Cuban capability and justification for their national independence.

Cuban-American relations remained shaky for many years after the successes of the Yellow Fever Commission. The Platt Amendment remained an ever-present reminder of American influence, and American economic interests remained a political force. The United States maintained and still maintains a military presence in Cuba at Guantánamo Bay. Strident debates over the roles of Finlay and Reed in the discovery of the mosquito vector of yellow fever continued as long as Cuban independence and American interests remained threatened.

Why then in 1955 did Americans and Cubans come together in Philadelphia to celebrate Finlay as a hero of tropical

medicine? In 1952 Fulgencio Batista staged a coup and seized power in Cuba. Shortly after his rise to power, the United States government recognized his regime. Batista protected American interests in Cuba and was anti-Communist in an era of Communist fear in the United States. Finlay's contribution had been denied by Americans when American interests were threatened by Cuban nationalists in 1900. In 1955, when U.S. interests were protected by the Cuban government, Finlay was honored. In both instances, the public perception of scientific discoveries was greatly influenced by the political climate.

The events that transpired over 100 years ago can also provide insight into our modern world where new and divergent scientific theories are emerging every day and science and medicine are constantly politicized. We must, of course, remain open to divergent theories that go against existing knowledge, but we must also be wary of the political manipulations of science and medicine.

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