Chianti Raddavero

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Professor Hanson

History of Carlos Juan Finlay and The Tail of Yellow Fever

A new "discovery" had been made by the Europeans during 1492. The new excitement of the era was establishing colonies in America. Colonies were civilizations, and areas that were under the control of another country. The concept was simple, for the well established European nations like England and Spain, their goal was to gain more control. At the time power was made possible by controlling land. Spain conquered most of South America while the rest of the Europeans focused more on Northern America. Spain had multiple colonies of *virreinatos (viceroyalty)*; Nueva España, Nueva Granada, Virreinato de Perú, y Río De la Plata. Nueva Espana was located in Southern California and Mexico. Cuba also fell under the same umbrella of the viceroyalty of Nueva Espana.

Cuba's Climate

Cuba's climate explains the existence of many pests and species alike. According to Climate Change Knowledge Portal, "The [Cuba] climate is defined as tropical, seasonally humid, with maritime influence and semi-continental features. Rainy period runs from May to October" (2020). Cubas overall weather is defined as tropical weather, and they have long rainy seasons. Cuba's climate allows for many species to thrive within their habitats. The article states, "*Anopheles* mosquitoes thrive in regions with warm temperatures, humid conditions, and high rainfall. Thus, tropical and subtropical areas are ideal" (UCAR, 2024). Cuba was a perfect

destination for mosquitoes to thrive. Mosquitoes need stagnant water (puddles) in order to keep their larvae alive. Since rainy seasons provide an abundance of still water, it's common for mosquitoes to thrive in that type of environment.

Figure #1 Aedes Albopictus Mosquito

Mosquitoes

Mosquitos are animals that can reproduce quickly and efficiently. They are also very small flying insects. Vector Disease Control International (2024) states, “females with an adequate food supply can live up to 5 months or longer, with the average female life span being about 6 weeks. To nourish and develop her eggs, the female usually must take a blood meal in addition to plant nectar. She locates her victims by the carbon dioxide and other trace chemicals exhaled, and the temperature patterns they produce”. Female mosquitos are the ones that have the capability to quickly reproduce, and need blood to survive. Female mosquitoes look for exhaling chemicals like carbon dioxide which typically attracts them to humans. Thus, mosquitoes are attracted to humans and in need of their blood. The combination of mosquitoes' ability to sense carbon dioxide and reproduce quickly explains the grave danger of the virus yellow fever.

What is Yellow Fever?

Yellow fever, according to Simon (2023), is a “mosquito-borne viral illness found in tropical and subtropical areas in South America and Africa. Transmission is primarily via Aedes and Haemagogus mosquitoes”. The virus will infect the mosquitoes and the mosquitoes will reproduce and bite humans transmitting the virus easily between hosts. The virus is known as the genus *Flavivirus* which is a virus that affects RNAt. According to Leslie V. Simon (2023), “Humans are infected through infected mosquito bites while visiting or working in the jungle”. The virus is generated from the contamination of blood meal taken from different mammals. Mosquitos thrive in warmer and wet climates, therefore jungles are places where the threat of yellow fever was very prominent.

Yellow Fever In Cuba

The first outbreak of yellow fever was 1648 in the Yucatan Peninsula. Yellow fever had reached Cuba during the same year of the initial outbreak. Yellow fever was referred to as such due to the yellow pigmentation that skin would acquire while being infected. Simon (2023) describes the internal effects of yellow fever on a subject, “The incubation period is 3 to 6 days. Once acquired, the virus quickly spreads to multiple organs in the body. The liver is the most important organ affected by yellow fever. It produces profound jaundice due to liver damage”. The virus acted quickly within the body. The spread of the virus to multiple organs would cause many physiological symptoms that patients would have exuded. PennMedicine, describes many symptoms and the three stages of yellow fever. Some of which include the infection stage, the remission stage, and finally the intoxication stage of the disease (Vyas, 2021). The toxic stage will most likely end in death of the patient. According to WHO, “Jaundice (yellowing of the skin and eyes, hence the name yellow fever), dark urine, and abdominal pain with vomiting. Bleeding can occur from the mouth, nose, eyes, or stomach. Half of the patients who enter the toxic phase

die within 7–10 days"(2023). The turnaround time for yellow fever to become deadly is quite rapid. Without vaccinations, or a true understanding of the cause of the virus it must have been difficult to prevent mortality due to yellow fever. According to the article, "By the end of the 19th century, during the brief Spanish-American War, fewer than 1,000 soldiers died in battle, but more than 5,000 died of disease in Cuba"(Brink, 2016). The violence and brutality of war was taking less lives in Cuba than a virus transmitted by small insects. In Cuba yellow fever was something that the people desperately needed to learn about in order to put an end to this fatal disease.

Figure #2 Carlos Juan Finlay

History of Carlos Juan Finlay

Finlay was born in 1833 in Cuba. His parents were both European and met in "Puerto Principe (now Camagiiey) Cuba". (Leonard, 1989). According to Leonard (1989), "His father, Edward Finlay, was a Scottish physician who sailed from England as a medical student in the early 1820s to join a British expeditionary force fighting under Simon Bolivar for the Liberation of Venezuela". Finlay's father, being a physician, was an important motivator for Finlay and his aspirations for his own life. Finlay would go on to follow in his father's footsteps and become a

physician in Havana, Cuba. Finlay's educational journey was very vast. He had studied in France, England, and the United States. Leonard (1989) describes, "In 1844, at age 11, he was sent to a French school at Le Havre. Two years later, an attack of chorea that left him with permanent slowness and confusion in expressing himself orally compelled him to return home to recover". Finlays experience with an illness himself may have encouraged his passion for medicine and later fever. Finally was condemned to live a life with the damages of a possibly fatal disease. He had to learn how to work through these challenges in order to become successful.

Finlay had a complicated journey when it came to obtaining his medical license. He bounced from school to school and even failed the oral examination that is mandatory for M.Ds. According to Leonard (1989), Finlay found himself at, "Jefferson Medical College in Philadelphia and studied under two men who were father and son Professor John Kearsly Mitchell, one of the first people to systematically maintain the germ theory of disease, and Dr. S. Weir Mitchell, only four years Finlay's elder, who served as his principal instructor at the college". Finlay's encounter with John Kearsly and Weir Mitchell proves to be very important when it comes to Finlay's later theories of Yellow Fever. By interacting with two individuals who presented the idea of germs and their ability to be transmitted host to host, Finlay was able to use their knowledge and apply it to his own observations.

Finlay's Approach to Yellow Fever Problem in Cuba

Finlay had opened a practice in Cuba where he used his time writing medical articles and expanded his knowledge on medicine. He had published many articles during his residency about all types of topics. Some of the topics were frowned upon by the Spanish Government, so Finlay wasn't taken seriously at his time. Yellow Fever has become an ongoing problem for Cuba.

Those who were natives, tended to not have as much of a threat to the disease compared to those who were foreign. According to the article, “Cuba was becoming a major port that received a steady stream of no nonimmune immigrants and transients, it stayed” (Leonard, 1989). Due to Cuba’s expanding economy and trade, Yellow Fever became very prevalent at the time, and threatened newcomers. Finlay, having a passion for science and all things medicine, attempted to create an initial theory on Yellow Fever. According to Leornard (1989), “Royal Academy in 1873 and the other in 1879, were entitled “Atmospheric Alkalinity Observed in Havana” and “Report of the Alkalinity of the Atmosphere Observed in Havana and Other Localities of the Island of Cuba”. Finlay had made multiple observations on the disease and created these two writings to acknowledge his current theories of why and how yellow fever is contracted.

The events of 1878 caused Finlay to begin to question his initial theory about Yellow Fever. The United States had now had outbreaks of Yellow fever during the time, and sent scientists and medical professionals down to Cuba to come up with solutions to the problem of Yellow Fever. As expressed before, Finlay’s educational background included multiple countries and cultures, so Finlay was able to obtain knowledge from many different countries. After Finlay realized that his initial hypothesis was flawed he determined, “1853 and deduced the following: First, Yellow Fever is a germ disease that can be transmitted only under certain topographic and climatic conditions. Second, the disease is not contracted through contact with patients, their secretions, or contaminated air, food, or drink. Third, pathologic lesions in the capillary walls of Yellow Fever patients and the hemorrhaging commonly associated with Yellow Fever suggest that blood vessel walls might prove a good source of the infectious agent” (Leonard, 1989). Finlay’s ideas in 1853 caused him to create the connection between Yellow Fever being related to blood and pathogens. From there he combined the ideas to lead himself to the first hosts of the

disease, mosquitoes. He then narrowed his studies and focused on mosquitoes' life cycle and tendencies.

Finlay had now created a theory but needed evidence in order to present it to society without immediately being shut down due to the lack of scientific proof. According to the text, “That was in February 1881. By the following August Finlay had received authorization to experiment and had begun exposing susceptible people to mosquitoes that had bitten yellow fever patients” (Leonard, 1989). By putting theories into practice Finlay attempted to conjure up susceptible evidence to share with society without the support of germ theory. Finally according to the scientific article by Leonard (1989), “14 August 1881 he presented the Royal Academy with what would become his most famous work, “‘The Mosquito Hypothetically Considered as the Agent of Transmission of Yellow Fever.”’Finlay had published the paper directly connecting mosquitoes and Yellow Fever together.

Finaly’s Theories Rejected

Finlay had the extensive scientific and medical background to deserve the respect from society but still was deprived of their respect. When Finlay presented his research the data and theory was disregarded by society. In Cuba at the time, it was uncommon for many of the medical standards we have today to even be fathomable during 1881. The text indicates Finlay himself even saying, “These experiments are certainly favorable to my theory”(Leonard, 1989). Here , Finlay represents the scientific attitude. The scientific attitude “frames and shapes the mindset of scientists as they both build and critique theories that are at the heart of scientific explanation”(McIntyre, 2019, p. 46). Finlay understood that his theory needed more evidence and should be tested again by other scientists. He was aware of the confirmation bias [“This occurs when we are biased in favor of finding evidence that confirms what we already believe

and discounting evidence that does not]”(McIntyre, 2019, p. 84) that his initial experiment provided. Finlay’s awareness of the missing pieces of his original experiment suggested that he truly was attempting to help society.

Yellow Fever Continues to Attack

Finlay made his discovery but society doesn't value his theories on mosquitoes having the ability to pass on the virus to human hosts. People still continued to contract Yellow Fever and die, especially those who were not native to Latin American or more specifically Cuba. The Spanish American War was from April 25, 1898 - December 10, 1898. The War was fought between Spain and the US for freedom from Spanish colonial rule. When the United States decided to invade Cuba, there was a very real threat of contracting Yellow Fever and other diseases. According to the text, “Secretary of War Russell Alger: ‘"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."’(American Experience, 2024). Yellow fever was a true concern for the United States army. The war itself is already dangerous and brutal, but the soldiers during the time had to also fight the unknown disease of Yellow fever. The text states, “At the onset of war with the United States, illness had decimated the Spanish fighting force, with 55,000 troops out of an army of 230,000 healthy enough to fight. U.S. officials were aware of the dangers from disease”(American Experience, 2024). So many foreigners in Cuba had died because of the Yellow Fever. These lives could have possibly been saved if society had considered Carlos Juan Finlay's theory of mosquitoes carrying the disease. Many Spanish and American soldiers lost their lives to the Spanish American war, but even more lost to the infamous Yellow Fever.

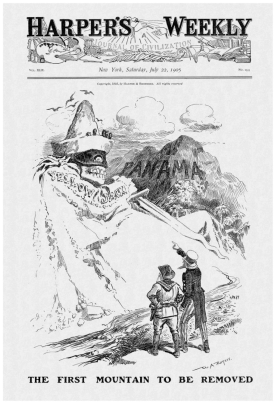

Figure #3 Cartoon of American Fears to Yellow Fever in Panama

The Effects of Yellow Fever On Americans

In 1881, the French made the efforts to build what we know as the Panama Canal. The goal of this project was to create a canal that would connect the Atlantic and Pacific Oceans, allowing a shortcut for trade routes. In 1904, the United States took over the project of the Panama Canal and eventually finished the build in 1914. The French, when they began construction, faced many issues, but primarily the presence of Yellow Fever. According to the article, "During the effort to build the canal in the 1880s, more than 22,000 workers from France died, many from Malaria and Yellow Fever, before the etiologies of those tropical diseases were understood" (Breedlove, 2021). Yellow Fever continued to take lives even after the Spanish American War. Unfortunately for the French, their project was rudely interrupted by the effects of a disease that should have been controlled long ago with the initial theory that was presented in 1881.

The Reed Commission

The Spanish American war had taken a toll on the United States soldiers with many of them having contracted Yellow Fever. The text states, "Surgeon General George M. Sternberg to

appoint a commission in 1900 to investigate the cause of the disease and how to prevent its occurrence"(Feng, 2015). A new commission had been created that would go into Cuba and finally put an end to the Yellow fever. Major Walter Reed was chairman of the commission and therefore his name is used to refer to the commission. The Reed Commission conducted experiments in order to find the reason for Yellow Fever. The text mentions "The commission disproved the bacterial theory and direct contact as causes for the spreading of the disease by having volunteer soldiers wear soiled clothing that belonged to infected patients over a period of time" (Feng, 2015). The commission approached the challenge by process of elimination. They had decided to eliminate the factor of bacteria connected to Yellow Fever in order to narrow down their research. Reed had then decided to look towards the ignored theory of Carlos Juan Finlay. He attempted to reproduce his experiment of mosquitoes biting infected individuals and then spreading the disease. According to the text, "Reed set up an experimental camp, Camp Lazear, in the jungle to continue the commission's work. Reed and his team systematically demonstrated that mosquitoes only picked up the yellow fever virus if they fed on a person during the first three days of infection"(Feng, 2015). Reed had remade and proven Finlays theory and due to his resources was able to find out even more specific information of how Yellow Fever is spread.

William C Gorgas was appointed the Chief Sanitation Officer in Cuba. The commission and Gorgas efforts now had an understanding of what causes Yellow Fever. The text indicates, "The only other solution was to eradicate the mosquitoes in Havana. Gorgas first enclosed yellow fever patients in screens to prevent mosquitoes from feeding and picking up the virus. He then ordered his team to fumigate every building in Havana and identified collections of water where mosquitoes might breed; he had those sources screened or drained, and even spread oil on

the surface. As a result of these efforts, cases drastically fell and, by 1902, there were no reported cases" (Feng, 2015). Yellow Fever had finally had a decrease in death tolls after many years of questioning how this disease came to be. Once the theory of mosquitoes was believed by society there was immediate action to get rid of mosquitoes.

The efforts put forth by the Reed Commission and Gorgas allowed for the United States successful construction of the Panama Canal. Without the new efforts put towards dealing with mosquitoes in Cuba, the Americans would have struggled just as the French did with their initial attempt at the construction. It took 19 years for Carlos Juan Finlay's theories to have the opportunity to be considered as factual.

Only IF

Carlos Juan Finlay was a well educated, medical physician. He had the opportunity to study all around the world and gather ideas from many different countries, scientists, and physicians. His theory on mosquitoes being the main cause of Yellow Fever was passed over, and not given the time of day to even be considered factual. It wasn't until 19 years later that a military constructed commission of medical professionals sat down and decided that Finlay's theory was in fact truthful. From the time of Finlay's theory to the Reed Commission, millions of lives were lost due to Yellow Fever. Those with Latin American backgrounds tended to be looked over when it came to scientific discoveries. Regardless of those individuals' experiences, education, or past accomplishments. The only thing that Northern Americans and Spain saw was their "inferior" creole dissonance.

Recognition At Last

Carlos Juan Finlay ended up passing away in 1915. He had been alive the entirety of the time of Yellow Fevers discoveries. From his theory of mosquitoes being presented in 1881, he

watched as so many people lost their lives to a disease he had already figured out the reason for. That didn't stop his efforts however, the text states, "Spanish-American War started he was assisting Cuban rebel groups in Tampa, Florida, and from there he went to Washington to volunteer for the U.S. expeditionary force. Not dissuaded from this course by his friend George Sternberg, now the Army Surgeon General, he was named assistant surgeon and joined the expeditionary force's military health service on 22 July 1898" (Leonard, 1989). Although Finlay's theory was ignored it didn't stop his efforts to provide assistance to put an end to Yellow Fever. George Sterberg was the creator of the Reed Commission which would eventually prove Finlay's theory. The creation of the commission was for the purpose of solving the problem of Yellow Fever. George Sternberg may have been Finlay's friend, the text states, "Sternberg rejected the mosquito theory, and only one commission member (Lazear) had any enthusiasm for it" (Leonard, 1989). Three out of the four members of the commission had no interest in even considering Finlay's theory of mosquitoes. They ended up testing the theory only because they couldn't think of a better option at the time. With no other option, the commission makes the choice to look into Finlay's theory. The text mentions, "[Finlay] who welcomed their inquiries, gave them copies of his published works, and provided eggs of the mosquitoes used in his research"(Leonard, 1989). Without any hesitation Finlay gave the commission that he was a part of all the information regarding his theory of yellow fever. According to the text after the "new" discovery of how and why Yellow Fever was passed and contracted Finlay became, "Chief Health Officer of Cuba from 1902 to 1909" (SC4 Library, 2024). The discovery of Yellow Fever was in 1901, so only after Finlay's theory was proven did he get the recognition he deserved for his countless works on Yellow Fever. Even when Finlay was helping the US general, and providing the commission with reach he wasn't fully respected.

Conclusion

There have been many discoveries made in Latin America. These discoveries have either been ignored or the credit of the discovery has gone to Europeans, or Northern Americans. During the time of Colonial rule those who were natives of their lands were treated as inferiors. Europeans didn't understand that there could be other ways of living in society. Due to this fear they decided to force their own beliefs and cultures onto their indigenous lands. Europeans did in fact provide the colonies with lots of beneficial tools and innovations. However, although the relationship between the two should have been autonomous, Europeans didn't take the native discoveries seriously.

As seen in the example of Yellow Fever with Carlos Juan Finlay. His theories were nonexistent to society as a whole, even when no other option was presented at the time to counter the beliefs he had. Carlos Juan Finlay was also considered to be a very well off native of Cuba, as both of his parents were Europeans. Finlay didn't even study in Cuba until much later in life, his education was primarily in France and the United states. It's a tough pill to swallow when it comes to the ignorance of society. Finlay wasn't a native physician that was educated in Cuba, he was educated by the same system of other Europeans, so why is it that his ideas were not considered? Finlay, although he fit in and was well rounded in all of society, still remained a Cuban born medical physician. The reason that Carlos Juan Finlay wasn't valued for his contributions to Yellow Fever sooner may have truly been due to his Cuban ethnicity. In conclusion, it's disappointing that many lost their lives to an “unknown” disease when the mystery had already been discovered in Cuba, by a physician named Carlos Juan Finlay.

Bibliography

Breedlove, B. (2021, August 27). *Special Wonders of the Canal - PMC*. PMC Home. https://pmc.ncbi.nlm.nih.gov/articles/PMC8314810/#:~:text=there's%20all%20this%20black%20smoke,those%20tropical%20diseases%20were%20understood.

Brink, S. (2016). *Yellow Fever Timeline: The History Of A Long Misunderstood Disease*. Npr. https://www.npr.org/sections/goatsandsoda/2016/08/28/491471697/yellow-fever-timeline-the-history-of-a-long-misunderstood-disease

Carlos Finlay (1833-1915) | American Experience | Official Site | PBS. (n.d.). PBS: Public Broadcasting Service. Retrieved October 27, 2024, from https://www.pbs.org/wgbh/americanexperience/features/fever-carlos-finlay/

Carlos Juan Finlay (1833-1915) - Hispanic and Latinx Scientists - Library at St. Clair County Community College. (n.d.). Home - SC4 Library - Library at St. Clair County Community College. Retrieved October 27, 2024, from https://esearch.sc4.edu/famouslatinxscientists/finlay#:~:text=Carlos%20Juan%20Finlay%20was%20born,two%20occasions%20because%20of%20illness.

Cuba - Climatology | Climate Change Knowledge Portal. (2021). Home | Climate Change Knowledge Portal. https://climateknowledgeportal.worldbank.org/country/cuba/climate-data-historical

Education, C. for S. (2024). *Climate Change and Vector-Borne Disease | Center for Science Education*. Home Page | Center for Science Education. https://scied.ucar.edu/learning-zone/climate-change-impacts/vector-borne-disease

International, V. D. C. (2016, September 15). *Aedes aegypti - The Yellow Fever Mosquito*. Vector Disease Control International. https://www.vdci.net/blog/mosquito-of-the-month-aedes-aegypti-yellow-fever-mosquito/

Isabel Lechuga, R., & Castro, C. (2017). *Dramatic effects of control measures on deaths from yellow fever in Havana, Cuba, in the early 1900s - PMC*. PMC Home. https://pmc.ncbi.nlm.nih.gov/articles/PMC5349382/

Faerstein, E., & Winkelstein, W. (2010). Carlos Juan Finlay: Rejected, Respected, and Right. *Epidemiology*, *21*(1), 158–158. http://www.jstor.org/stable/25662824

Feng, P. (2015, January 28). *Major Walter Reed and the Eradication of Yellow Fever - The Army Historical Foundation*. The Army Historical Foundation; https://www.facebook.com/NatlArmyMuseum. https://armyhistory.org/major-walter-reed-and-the-eradication-of-yellow-fever/

Leonard, J. (1989). Carlos Finlay's Life and the Death of Yellow Jack1 . *Feature* .

Life Cycle: Mosquito Biology 101. (n.d.). Vector Disease Control International. Retrieved October 27, 2024, from https://www.vdci.net/mosquito-biology-101-life-cycle/

McIntyre, L. (2019). *The Scientific Attitude*. MIT Press.

Qi, R., & Yu, X.-J. (2024). *Flaviviridae - an overview | ScienceDirect Topics*. ScienceDirect.Com | Science, Health and Medical Journals, Full Text Articles and Books. https://www.sciencedirect.com/topics/immunology-and-microbiology/flaviviridae#:~:text=The%20Flaviviridae%20are%20a%20family,e.g.%2C%20Pestivirus%20A%20virus).

Scourge of the Spanish American War | American Experience | Official Site | PBS. (n.d.). PBS: Public Broadcasting Service. Retrieved October 27, 2024, from https://www.pbs.org/wgbh/americanexperience/features/fever-scourge-spanish-american-war/

Simon, L. V. (2023). *Yellow Fever - StatPearls - NCBI Bookshelf*. National Center for Biotechnology Information. https://www.ncbi.nlm.nih.gov/books/NBK470425/#:~:text=Yellow%20fever%20is%20a%20mosquito,severe%20hemorrhage%20and%20liver%20disease.

Sutter, P. (2016, April 21). *"The First Mountain to Be Removed": Yellow Fever Control and the Construction of the Panama Canal - PMC*. PMC Home. https://pmc.ncbi.nlm.nih.gov/articles/PMC8932943/

Vyas, J., Zieve, D., & Conaway, B. (2021, November 23). *Yellow Fever* . Penn Medicine .

Yellow fever. (2023, May 31). World Health Organization (WHO). https://www.who.int/news-room/fact-sheets/detail/yellow-fever#:~:text=In%20this%20phase%2C%20people%20are,die%20within%207%E2%80%9310%20days.