

The Moth in the Iron Lung

By Forrest Maredy

Summary

Introduction

The book explores the history of polio, focusing on the events leading up to the epidemics in the late 19th and early 20th centuries. It questions the common narrative that polio was solely caused by the poliovirus and suggests that other factors, such as the widespread use of pesticides like lead arsenate and DDT, may have played a significant role in the rise of the disease. The author argues that the interaction between these toxins and various microbes, including the poliovirus, created the perfect conditions for the nervous system to be compromised, leading to the paralytic symptoms associated with polio.

The book also examines the development of the iron lung, a mechanical respirator that became synonymous with polio, and the eventual decline of the disease following the reduction in the use of certain pesticides. The author aims to provide a more comprehensive understanding of the polio story, challenging the conventional wisdom that the development of the polio vaccine was the sole factor in the disease's decline.

Boston, 1869 & England, 1832 (175 words): In 1869 Boston, a man frantically searches for a lost mass of gypsy moth eggs outside his home, fearing the destruction they could cause as an invasive species. The chapter then shifts to England in 1832, where an Irish physician designs a device for artificial respiration to aid drowning victims. The author notes that while drowning and coal mining-related asphyxiation were known threats, the disease that would become synonymous with artificial respiration machines, polio, was still unheard of at the time.

Key numbers:

- The artificial respiration device used a bellows attached to a reciprocating piston to create a vacuum inside a box, forcing the patient's chest to expand and draw in air.

Philadelphia, 1867

Charles Taylor, a surgeon in Philadelphia, publishes a work on infantile paralysis, noting its increasing frequency and the tendency to affect the poor less than diseases like tuberculosis. He mentions that both parents and doctors attribute the onset of paralysis to teething, with one father testifying that his daughter's leg weakness was discovered when she resumed walking after a period of debility due to teething.

The author suggests that the paralysis associated with teething may have been caused by the widespread use of mercury-containing teething powders, such as Steedman's Teething Powders, which contained high doses of mercury chloride. The use of these powders was believed to be essential for clearing infants' bowels during teething, despite the known toxicity of mercury.

Legs & Lungs

This chapter discusses the common pattern of infantile paralysis in the 1800s: a healthy child would go to bed, wake up thirsty, and then be found unable to move their legs the next morning. The paralysis often affected the legs, occasionally the arms, trunk, or abdomen. The author notes that the selective targeting of the legs by the disease remains a mystery, as there appears to be no unique anatomical feature explaining this preference.

The loss of leg function was particularly devastating in the 1800s due to the lack of wheelchairs and paved roads. If movement was not regained quickly, the affected muscles would atrophy, and the bones would grow unevenly, leading to the contorted posture associated with poliomyelitis. In rare cases, the paralysis could ascend to the respiratory muscles, leading to difficulty breathing and the need for artificial respiration, which was often unavailable or unaffordable for most people in the 19th century.

Boston, 1889 & Boston, 1893

In 1889, Medford residents awoke to find their trees stripped bare by gypsy moth caterpillars. The pests consumed gardens and fruit, infested houses, and proved difficult to eradicate. In response, a newly developed pesticide called lead arsenate was employed, which was more effective and adhesive than the previously used Paris green.

By 1893, lead arsenate was widely sprayed in the Boston area to combat the gypsy moth infestation. However, in November of that year, an article in the Boston Medical and Surgical Journal questioned whether acute poliomyelitis was unusually prevalent that season, reporting 26 cases, the largest recorded outbreak in America at the time. The author suggests that the aggressive spraying of lead arsenate may have triggered this outbreak, as arsenic poisoning had been shown to cause lesions in the spinal cord similar to those seen in poliomyelitis.

Key numbers:

- 26 cases of poliomyelitis reported in Boston in 1893, the largest recorded outbreak in America at the time.

Vermont, 1894

In the summer of 1894, Charles Caverly, a physician and President of the Vermont State Board of Health, began receiving reports of unexplainable "acute nervous disease" accompanied by paralysis in children from Rutland, Vermont. By September 1st, 123 people were affected, and 18 died, many of them children. This outbreak is considered the first epidemic of polio in the United States.

However, a closer examination of the cases suggests that the cause may have been more complex. Many of the symptoms reported, such as convulsions, urticarial blotches, and death without paralysis, were inconsistent with a modern understanding of polio and instead pointed towards arsenic or lead poisoning. The author proposes that the recent introduction of lead arsenate in the area, used by farmers to protect their crops from the codling moth, may have played a role in the outbreak.

Interestingly, the paralysis and nervous disorders affected not only people but also animals such as horses, chickens, and dogs. This is significant because the poliovirus is known to be incapable of causing paralysis in most animal species, except for a few primates. The fact that a wide range of animals were affected suggests that the cause of the paralysis was likely not the poliovirus alone.

Key numbers:

- 123 people affected, 18 died in the 1894 Rutland, Vermont outbreak
- Horses, chickens, and dogs also suffered from paralysis and nervous disorders during the outbreak

Direct quote: "It is of course regrettable that neither of these instances of disease in the lower animals was discovered in time to have adequate pathological or bacteriological examinations made. They emphasize, however, the facts: that the disease affects lower animals, that it occurs in connection with the disease in the human family, and that there are good prima facie reasons for thinking there may be a common cause for cases in man and the lower animals, and that it maybe communicated from animals to man and vice versa." - Charles Caverly, 1910

Rochester, 1920

In the summer of 1920, the Eastman Dental Hospital in Rochester, New York, conducted a large-scale campaign to remove the tonsils and adenoids of children, believing that this would protect them from various diseases. The procedure was performed on around 1,500 children over seven weeks, with 40 children undergoing surgery each day.

As tonsillectomies became more common, a disturbing trend emerged: children who developed poliomyelitis after the surgery often suffered from bulbar poliomyelitis, a rare and severe form affecting the brainstem. This type of poliomyelitis was associated with inflammation and nerve damage in the medulla oblongata, which is located near the tonsils. The author suggests that the surgery itself may have facilitated the entry of the poliovirus or other causative agents into the nervous system, leading to the development of bulbar poliomyelitis.

Key numbers:

- Approximately 1,500 children had their tonsils and adenoids removed over seven weeks
- 40 children underwent the procedure each day

Campobello, 1921 & Roosevelt

In the summer of 1921, Franklin Delano Roosevelt, who had recently lost his bid for the vice presidency, traveled to his summer home on Campobello Island. After a few days of strenuous activities, including sailing, firefighting, and swimming, Roosevelt fell ill with a fever and progressive paralysis in his legs. He was eventually diagnosed with poliomyelitis by an expert physician from Boston.

The news of Roosevelt's illness shocked the nation, as poliomyelitis was considered a disease that primarily affected children, especially those from immigrant families. The fact that a prominent, healthy adult like Roosevelt could be stricken was a wake-up call that no one was immune to the disease.

However, the author questions whether Roosevelt's illness was caused by the poliovirus, noting several inconsistencies between his symptoms and the typical progression of paralytic polio. For example, Roosevelt experienced paralysis before the onset of fever, whereas poliovirus infections usually cause fever and general illness before paralysis occurs. Additionally, Roosevelt suffered from severe pain and hyperesthesia (sensitivity to touch), which are not common symptoms of polio.

Given Roosevelt's fondness for fruits and berries, which were likely sprayed with lead arsenate, the author proposes that pesticide poisoning may have played a role in his illness.

However, the presence of mild symptoms in Roosevelt's children suggests that an infectious agent might have also been involved.

While it is impossible to definitively diagnose Roosevelt's condition, the author argues that he likely developed lesions in his spinal cord consistent with poliomyelitis but that the cause may not have been the poliovirus specifically. Regardless of the cause, Roosevelt's battle with paralysis and his subsequent advocacy for polio research greatly increased public awareness and funding for the fight against the disease.

Key numbers:

- Roosevelt was 39 years old at the time of his illness

Direct quote: "I'd never felt anything so cold as that water! I hardly went under, hardly wet my head, because I still had hold of the tender, but the water was so cold it seemed paralyzing. This must have been the icy shock in comparison to the heat of the August sun and the heat of the tender's engine." - Franklin D. Roosevelt, describing his fall into the water shortly before his illness began

Boston, 1928

In October 1928, an eight-year-old girl at Boston Children's Hospital was suffering from respiratory failure due to poliomyelitis. Philip Drinker, an engineer consulted on maintaining proper air temperature in the hospital's premature infant ward, suggested that the girl might benefit from an artificial respiration machine he had developed.

Drinker's machine, known as the "iron lung," was a sealed cylindrical chamber with a gasket for the patient's neck. Electrical pumps created negative and positive pressure within the chamber, expanding and contracting the patient's lungs to simulate natural breathing. Although the girl ultimately died after five days in the device, likely due to complications from bronchopneumonia, the iron lung showed promise in its ability to provide prolonged artificial respiration.

The first successful use of the iron lung came shortly after, when a 22-year-old student named Barrett Hoyt was stricken with poliomyelitis and experiencing respiratory failure. Hoyt was placed in the iron lung and reported immediate relief, famously whispering, "I breathe." After months in the device, Hoyt regained the ability to breathe on his own and was discharged from the hospital.

As news of the iron lung's success spread, hospitals across the country began acquiring the devices, offering hope in the battle against the most devastating effects of poliomyelitis. However, the machines were expensive and not widely available outside of large metropolitan areas for several decades.

Direct quotes:

- "I breathe." - Barrett Hoyt, upon being placed in the iron lung
- "During the time the child was in the respirator, she was able to talk, sleep, and take nourishment while the pumps were running." - Philip Drinker, on the eight-year-old girl's experience in the iron lung

Los Angeles, 1934

In the summer of 1934, Los Angeles experienced a peculiar poliomyelitis epidemic. While the disease typically affected children, this outbreak saw a high number of adult cases, particularly among doctors and nurses working at the Los Angeles County Hospital. The affected medical professionals exhibited symptoms that differed from the usual presentation

of poliomyelitis, such as severe headaches, muscle aches, and fatigue, with paralysis being largely absent.

Overwhelmed by the scale of the outbreak and the unusual nature of the cases, Los Angeles Health Officer George Parrish requested assistance from the Rockefeller Institute in New York. Scientists Dr. Leslie T. Webster and Dr. John Paul traveled to Los Angeles to investigate the epidemic but found that poliovirus seemed to be nearly absent in the samples they collected. They were only able to isolate the virus in a small percentage of cases and struggled to induce paralysis in their monkey test subjects.

Dr. Edward Rosenow, a proponent of the theory that a specific form of streptococcus bacteria caused poliomyelitis, also arrived in Los Angeles to assist with the investigation. He suggested that the difficulty in isolating the poliovirus was simply because it was not the cause of the outbreak.

The author proposes that the symptoms experienced by the hospital staff more closely resembled chronic lead poisoning, possibly due to the hospital's recent construction and the presence of lead paint and dust. The fact that short-term patients and family members of the staff were unaffected supports the idea that an environmental factor within the hospital, rather than an infectious agent, may have been responsible for the illness among the staff.

Key numbers:

- 1,792 residents of Los Angeles County were diagnosed with poliomyelitis during the outbreak
- 198 hospital employees (5.4% of physicians and 11% of nurses) were affected

Chicago, 1960

In May 1960, a group of scientists and physicians gathered in Chicago to discuss the concerning resurgence of poliomyelitis cases, particularly the paralytic form, in the United States during the late 1950s. The meeting focused on the apparent shortcomings of the Salk vaccine, an injected vaccine developed by Jonas Salk using formalin-inactivated poliovirus.

Several issues with the Salk vaccine were addressed, including the manufacturing difficulties that led to the distribution of improperly inactivated vaccine in 1955, causing paralysis and death in some recipients. Additionally, the vaccine's efficacy was questioned, as many individuals who had received multiple doses still contracted paralytic polio.

Dr. Herbert Ratner, the conference moderator, highlighted the vaccine's inability to prevent the spread of poliovirus, as it only induced antibodies in the bloodstream and not in the intestinal tract where the virus replicated. This limitation meant that vaccinated individuals could still harbor and transmit the virus, making the goal of eradicating polio through vaccination more challenging.

Attendees also discussed the potential advantages of the upcoming oral polio vaccine, developed by Albert Sabin, which used live attenuated poliovirus strains. The oral vaccine was expected to induce a more comprehensive immune response, including intestinal immunity, and provide better protection against paralysis. However, the live vaccine carried the risk of the attenuated virus reverting to a virulent form and causing vaccine-associated paralytic poliomyelitis in rare cases.

Dr. Bernard Greenberg, a biostatistician, criticized the "double talk" surrounding the Salk vaccine's efficacy, pointing out that the decline in polio cases from 1955-1957 was largely a "statistical artifact" resulting from changes in diagnostic criteria and improved differentiation between poliomyelitis and other enteroviruses.

The conference highlighted the ongoing challenges in understanding and controlling poliomyelitis, despite the widespread use of the Salk vaccine. It also foreshadowed the upcoming shift towards the oral polio vaccine as a potentially more effective tool in the fight against the disease.

Direct quote: "One of the most obvious pieces of misinformation being delivered to the American public is that the 50 per cent rise in paralytic poliomyelitis in 1958 and the real accelerated increase in 1959 have been caused by persons failing to be vaccinated. This represents a certain amount of 'double talk' and an unwillingness to face facts and to evaluate the true effectiveness of the Salk vaccine." - Dr. Bernard Greenberg

Epilogue

The iconic photograph of iron lungs lined up in the auditorium of Rancho Los Amigos Hospital in Los Angeles has become a symbol of both the horrors of polio and the triumph of modern medicine. However, the author argues that this interpretation overlooks the true cause of the polio epidemic—the widespread use of pesticides like lead arsenate and DDT, which created a perfect storm of environmental factors that allowed the poliovirus and other pathogens to cause unprecedented harm.

The author notes that while paralytic polio has largely disappeared in the United States, it still occurs in other forms, such as acute flaccid paralysis and transverse myelitis. The iron lung has been replaced by more advanced positive pressure ventilators, which are less visually striking but serve the same purpose.

The author also addresses the misconception that polio was eradicated solely due to the development of vaccines, pointing out that the decline in polio cases coincided with the reduced use of lead arsenate and DDT in the United States. Countries that still heavily use these pesticides, like India, continue to struggle with polio and other forms of paralysis, despite extensive vaccination programs.

The epilogue emphasizes the importance of critically examining the historical narrative surrounding polio and acknowledging the role of environmental factors in the disease's rise and fall. By doing so, we may be better equipped to understand and prevent similar health crises in the future.

Direct quote: "The fact that nearly anyone can look at this picture and wax nostalgic about the miracle of vaccines—rather than the danger of ingested metals and pesticides—is an epic failure of human narcissism."

Commentary

The author challenges the popular belief that the rise in poliomyelitis cases was due to improved sanitation, which supposedly prevented children from safely acquiring immunity through early exposure to the poliovirus. He argues that this theory fails to explain why infants were the most common victims of paralysis, as they should have been protected by maternal antibodies if better sanitation was the cause.

The author also questions the role of Etienne Trouvelot and his escaped gypsy moths in the emergence of epidemic poliomyelitis, suggesting that while the development of lead arsenate was a direct result of the gypsy moth invasion, other factors would have likely led to similar outcomes.

The commentary emphasizes the impact of Koch's postulates on poliomyelitis research, which narrowed the focus to finding a single causative agent and overlooked the possibility of multiple causes, including environmental factors.

Lastly, the author draws parallels between the polio story and the recent Zika virus outbreak, highlighting how a rushed focus on developing a vaccine can lead to the neglect of investigating other potential causes of a health crisis.

Key numbers and statistics:

- In the 1916 New York City outbreak, only 5% of families experienced more than one case of poliomyelitis.
- In 1952, entire families were stricken with poliomyelitis, with up to 11 children in a single family affected.
- During the height of DDT spraying, one newspaper article recommended using 11 pounds of DDT per 1,000 square feet to control chinch bugs, which would amount to nearly 240 pounds on a half-acre residential property.
- A USDA report indicated that a single application of DDT could continue to kill insects up to five years later.
- In an outbreak near Detroit, Michigan, in 1958, 869 people were diagnosed with polio, but exhaustive studies concluded that only 292 actually had the poliovirus.
- By the end of 1957, only 221 people died from poliomyelitis in the United States, a sharp drop from 3,145 deaths in 1952.
- A study found that strawberries sprayed with lead arsenate contained an average of 11.5 mg of arsenic per strawberry.
- The period from 1885-1889 saw only 23 cases of suspected poliomyelitis in the entire United States. From 1890-1894, there were 151 cases across four epidemics, and from 1895-1899, there were 23 epidemics. The number of epidemics increased to 25 between 1905-1909, with over 8,000 people affected.
- In 1935, children were developing poliomyelitis directly after receiving the Kolmer vaccine at rates as high as 1 in 1,000, with many dying as a result.

Relevant quotes: "The gypsy moth, the codling moth, and all of the other invasive species which had been fought so doggedly by generations of farmers continue to thrive—their legacy not only visible in the disturbed ecosystems they leave in their wake, but the withered limbs and wheelchairs which still dot the country."

"Perhaps the unvarnished account of polio will one day come to light and will rightly take its place in history as a portent of the arrogance of man—a change which would be most welcome. Humans will continue to prefer the heroic journey, and there are far more deserving stories to tell."