The 1900 San Francisco plague is a significant event in which citizens, physicians, and public health officials denied a diagnosis of plague on economic, political, and social grounds. To resolve the controversy, Surgeon General Walter Wyman appointed an independent federal commission of university-based experts to investigate whether plague was present. I use the activities of Frederick Novy, the commission bacteriologist and professor at the University of Michigan, to explore one circumstance in which bacteriology attempted to redefine traditional conceptions of disease during the early germ era. Novy showed plague was present in the city but without its characteristic clinical features and devastating epidemiological pattern. Physicians who understood plague by its classic features, however, contested Novy’s scientific evidence. His bacteriologic redefinition had no special authority to prevail over opposing conceptions about plague; it was accepted and acted upon once it served the overall interest of the city—to avert a trade embargo.

1900 SAN FRANCISCO OUTBREAK

In 1899, the mainland United States had been spared of dreaded bubonic plague epidemics [1]. There had been recent reappearances of plague in Canton and Hong Kong (1894), Bombay (1896), Alexandria (1899), and Honolulu (1899) [2]. As it was open to international commerce, US Surgeon General Walter Wyman grew uneasy that plague could spread from these locales through established trade routes to San Francisco [3]. Thus, it seemed to Wyman that San Francisco, a product of expansion of world trade and immigration, would be vulnerable to plague.

Anticipating that quarantine may be required, Wyman in June 1899 transferred Joseph Kinyoun from the federal Marine Hospital Service (MHS) in Washington, to San Francisco to serve as the quarantine station officer [4]. Although Kinyoun lacked first-hand experience with plague, he was an expert in the new science of bacteriology, having made the first bacteriologic diagnosis of cholera in the United States in New York City in 1887 [5]. As had been the case in other cities in which plague occurred, Kinyoun reasoned that plague-carrying rats could be introduced into San Francisco through unloaded cargo. In his MHS laboratory on 6 March 1900, using culture techniques and animal inoculation experiments of inguinal gland aspirates taken from a 41-year-old Chinese man, Kinyoun identified the plague bacterium, *Bacillus pestis*, as the cause of death [4]. Kinyoun felt certain of his diagnosis, which he asserted “was made after the most searching examination wherein every demand of science was fulfilled” [4].

Notwithstanding his confidence, some elected officials, business leaders, and Chinese living in Chinatown rejected Kinyoun’s conclusion that plague was present. Politicians and some business leaders feared that the presence of plague would diminish the growth of San Francisco, where the trade industry was thriving, since outbreaks of plague historically shut down trade in port cities [6]. Also, local physicians and public health officials resented the intrusion of federal health officers, whom they considered meddlesome, in their affairs [5]. In addition, the presence of plague in
indigent Chinese provided grounds for racially motivated public health practices, including cordoning off of Chinatown from San Francisco [7, 8]. To counter such discrimination, the Chinese population denied Kinyoun’s diagnosis and concealed their sick and dying from health officials [9]. Moreover, local newspapers contested Kinyoun’s sanitary measures directed at Chinatown on grounds that they would unnecessarily deplete city funds [10]. Despite opposition from skeptical politicians, anxious businessmen, dubious physicians, and concerned Chinese, Kinyoun was steadfast that plague showed no signs of abating as by August 1900 he had confirmed 13 deaths due to plague [4]. Because politicians and citizens of San Francisco refused to implement measures to control the problem of plague as identified by his federal quarantine officer, Wyman decided to opt for an assessment by experts who were not employed by the MHS or who did not have ties to local California interests. Wyman assembled a commission in January 1901 consisting of prominent scientists who, unlike Kinyoun, had first-hand experience with plague [3]. Wyman selected Simon Flexner, professor of pathology at University of Pennsylvania as director; Lewellys Barker, professor of pathology at University of Chicago as secretary; and Frederick Novy, associate professor of physiologic chemistry and bacteriology at the University of Michigan as bacteriologist. [Figure 1] Flexner and Barker had field experience during the 1897 Philippines plague epidemic, and Novy had laboratory expertise identifying plague [3].

WHO WAS NOVY?

Frederick Novy (1864–1957) was a leader among a new breed of full-time, university-based bacteriologists in America. Novy studied chemistry as an undergraduate at the University of Michigan. Upon graduation in 1886, he received a doctorate in physiological chemistry in 1890 before receiving a medical degree from Michigan in 1891 [11]. As a medical student, Novy learned bacteriology in the hygienic laboratories of Robert Koch in Berlin and Louis Pasteur in Paris. After returning to America in 1891, Novy was hired as instructor in hygiene and physiological chemistry at Michigan [11]. By 1901, he was recognized worldwide by scientists and physicians for his research and medical education work [11]. By innovating new culture techniques, he demonstrated the presence of microbes, including anaerobic bacteria like Clostridia novyi, in various clinical situations [12]. He developed tools to search for, view, and understand the behavior of microbes that cause human disease, including trypanosomiasis, leishmaniasis, and relapsing fever [11]. Novy also initiated a lecture-laboratory course in microbiology at Michigan in 1889—the first offered in America [13]. Shortly thereafter, major American medical schools modeled their bacteriology courses after Novy’s [14]. Wyman assumed that Novy’s unsurpassed scientific reputation and the independent status that his university base afforded him would render his opinion unassailable by those who rejected Kinyoun’s conclusion [3]. Wyman said “the findings of Novy, an expert on bacteriology, working entirely independently of the bureau, will result in a satisfactory settlement of the denials that have been made” [3]. Why did Wyman believe that Novy’s opinion would prevail over conflicting views of plague? During a time of growing tensions between federal health bureaus and local health departments [6], Wyman may have felt that Novy would avoid opposition from local citizens that the MHS-affiliated Kinyoun experienced. Wyman may also have felt that Novy’s personal laboratory experience handling plague and his rigorous scientific methodology would yield universally valid conclusions that were more coherent.
than those who disputed Kinyoun’s diagnosis. If plague was the cause of the outbreak, perhaps the word of an independent expert could lead to the implementation of satisfactory control measures without engendering dissent. Or so Wyman may have thought.

1901 PLAGUE COMMISSION INVESTIGATION

As Novy arrived in San Francisco on 27 January 1901, he realized that citizens and the local press who denied the diagnosis of plague had also assailed the commissioners’ credibility. To his wife Grace, Novy wrote that “The Gov[ernor] of California denies the existence of the disease in San Francisco. The press and people are unanimously against the idea that the plague exists here” [15]. A local paper, The Bulletin, had reported Governor Henry Gage was “skeptical of the commissioners’ technologic knowledge” and denigrated their “university experience rather than practical experience” [16]. Novy suspected that the objection to Kinyoun went beyond his association with the MHS and involved a repudiation of any scientist whose findings threatened the prosperity of the city. Novy said, “The newspapers and gov[ernor] feel that they must not be guided by bacteriological evidence. They will in the end lambaste us just as they have done to Kinyoun should we find plague” [15].

Novy recognized that their investigation could be paralyzed not only by their inability to access diseased bodies being concealed by the Chinese but also because the governor had been promoting bills in the State Assembly to make it illegal to handle the plague bacillus [15]. Also, the governor had pressured a University of California bacteriologist, Alonzo Taylor, to recall permission for the commissioners to use his laboratory to obtain independence from the MHS to comply with Wyman’s request. Acknowledging that “the object of this whole thing is to stop our work,” Novy vowed “we’ll get ahead of his honor.”

The commissioners accomplished this by meeting daily in “bureau” meetings with a group of influential businessmen to seek their assistance in overcoming what they considered to be interference with their investigation [17]. Requesting support for an investigation that could guarantee a quick end to the epidemic threat and a prompt return to trade, all 3 commissioners persuaded the businessmen to help defeat the Governor’s bills in the legislature, arrange for a Chinese interpreter Wong Chung to personally accompany them to the bedside of ill Chinese, and arrange for a licensing room in City Hall to be converted to a microbiology laboratory [17]. The commissioners promised to limit their examination to an incision of enlarged glands and spleens; this helped to respect a cultural wish among Chinese to have bodies remain undisturbed after death in order to be transported to the deceased’s native country for burial [17]. The alliance forged with influential businessmen enabled the commissioners to convince politically appointed city officials and Chinese residents that they all had a shared interest in finding the cause of death through the application of bacteriology.

The commissioners began their daily rounds of visits to Chinatown on February 5. With the help of Wong Chung, they gained access to ill Chinese and made rapid clinical (Barker) and pathological (Flexner) examinations and bacteriologic tests (Novy) in those who were ill with fever, splenomegaly, or enlarged glands [17]. On February 7, Novy identified the plague bacillus in his first case and recorded his raw data in his laboratory notebook [18] (Figure 2). Using specimens obtained from the spleen and blood of a febrile 44-year-old Chinese man who died without buboes, Novy identified colonies of B. pestis on the surface of solid bouillon agar and slight growth along the line of inoculation of stab cultures in glucose gelatin [18]. He inoculated both a pure culture of the isolate and a clinical specimen into a healthy guinea pig [18]. He then identified the organism in pure cultures taken from the diseased gland of the experimental animal [18] (Figure 2). Having satisfied Koch’s criteria for causality, Novy concluded “plague was present beyond possible doubt” [18]. Between February 5 and 16, Novy identified B. pestis as the cause of death in 6 of 13 people; 2 of whom had no buboes.

In their confidential report mailed to Wyman on February 26, the commissioners stressed the indispensible role they believed bacteriological testing played in the diagnosis of plague especially in light of its variant behavior in San Francisco [19]. Noting that plague can present with fever alone, Novy argued that “it is difficult to make a diagnosis of plague without bacteriological examination… In the absence of primary buboes, the unskilled observer will miss practically every case, and even the practitioner who has had much experience with plague may be deceived” [19]. In a separate report, Novy then tabulated the mortality from all causes among the Chinese population in San Francisco from 1897 to 1901, noting that the cumulative number of deaths remained stable at approximately 430 per year [20]. He concluded that “at no time during the past 4 years has the mortality rate among the Chinese increased to such extent as to in itself cause alarm” [20].

Novy used his bacteriological testing to underscore that the behavior of plague in the individual and the dynamics of the disease in the San Francisco population differed from classic patterns of plague described in medical texts. Yersin identified the microbial cause of plague during a devastating 1894 Hong Kong epidemic but did not describe clinical variations [21]. Subsequently, experts like Novy defined plague according to its massive depopulations—as an infectious epidemic that spread like a “great tidal wave with unusual force” and whose “excessive mortalities caused frightful ravages throughout history” [22]. He acknowledged that plague could begin
slowly, a form called *pestis minor*, but argued this form would become a devastating epidemic within 1 year [22]. In addition, for many physicians with whom Novy had met in San Francisco, plague conjured a dramatic iconography of an epidemic spreading rapidly and extensively, and causing desolation of cities, social disruption, and alarm [17]. Novy acknowledged that those viewpoints were tenable [18]. Nonetheless, on the basis of his microbiologic evidence, Novy argued that plague could also be present in a nonepidemic form. Fever alone, in the absence of buboes and a rapid progression to death, he argued, could also represent plague.

After returning to his Michigan laboratory, Novy began to initiate experiments in April 1901 to explore a biologic basis of plague’s aberrant behavior. Kinyoun, now restationed as MHS quarantine officer in Detroit, continued to denounce California for prioritizing business interests above duties to protect health” [4]. Barker and Flexner continued to write about their plague experience in San Francisco after returning to their respective institutions, but confined their comments to the clinical and pathological aspects of plague. Novy had shipped a specimen prior to his departure from San Francisco to one of his Michigan laboratory assistants, Charles Hare [15]. Novy’s laboratory notebooks show that he began to explore the possibility of slow growth and attenuated virulence by measuring the organism’s growth and metabolism under varying experimental conditions [23]. But experiments were aborted when Hare developed acute pneumonic plague as a result of an accidental introduction of the microbe to Hare’s mouth through the use of a pipette, soiled finger, or cigarette [20]. Hare survived, and Novy conceded that he could not explain the biological basis of plague’s atypical behavior in 1901 [24], which remains poorly understood today. Nonetheless, he concluded that the episode provided additional bacteriological evidence that plague was present in San Francisco and that there was no cause for alarm as no additional cases occurred in Michigan after Hare was isolated in the hospital [25]. Novy was also heartened by what he considered “prompt measures being initiated to make sure the disease in San Francisco is stamped out” [26].

**THE COMMUNITY RESPONDS**

Novy was referring to sanitation measures in Chinatown that Governor Gage initiated in March 1901 following the commissioners’ investigations [27]. Gage implemented these measures as part of a deal he had made with Wyman in return for suppression of the commissioners plague report [27]. Wyman eventually approved the report for publication, as was his legal obligation [27], and the local and national press credited Gage’s sanitary efforts as effective actions against plague [28]. But the sanitary measures were costly, and Gage believed they were unnecessarily depleting his $100,000 budget earmarked for handling epidemic diseases [29]. Furthermore, in the absence of a massive epidemic, some practicing physicians in the city rejected Novy’s bacteriological diagnosis of plague [30]. To provide the counterevidence he would need to rescind his sanitary measures, Gage appointed a hand-picked “State Special Health Commission” composed of practicing physicians who denied that plague was present in Chinatown [31]. On the basis of a state commission evaluation between April 1901 and October 1901 in which they found no plague in 145
deaths, Gage terminated sanitary measures in Chinatown in October 1901 [31].

Meanwhile, the local health department continued their own investigation of Chinese deaths. They reported an increase in the number of deaths due to plague in San Francisco from 38 in July 1901 [32] to 74 by July 1902 [33]. Novy, noting the withdrawal of control measures despite an increasing plague incidence, reversed his previously favorable comments about the handling of plague. In January 1902, he said, “the disease is slowly gaining headway and unless stamped out in the city it will sooner or later suddenly expand over the whole country” [34]. The scientific and medical press, guided by evidence provided by the federal commissioners that plague was present, concurred [33, 35]. Novy called for “reinstatement of antiplague measures, including rat eradication, to prevent its spread throughout the US” [24].

In January 1903, threats of economic sanctions against the state forced California to take decisive measures to prevent its spread throughout the nation. In part for not acting decisively during plague outbreak, Gage failed to win the nomination of the Republican Party for reelection in 1902 [36]. Shortly after Gage’s opponent, George Pardee, was inaugurated governor in January 1903, he initiated efforts to ward off the continued threat of quarantine against California [36]. Pardee traveled to a special bubonic plague conference at the Department of Treasury in Washington, DC, and promised delegates from the State Public Health departments that San Francisco would take immediate and vigorous action against plague [37]. In return for the state carrying out effective action against plague, the delegates agreed not to place an embargo on railroads leading out of California [37].

In February 1903, Pardee, with the City and State Board and directed by Rupert Blue of the MHS, initiated a comprehensive program [38]. The activities included removing decaying wooden balconies and porous wooden cellars that were suitable for harboring rats and replacing them with hardened, rat-proof concrete basements [10]. Blue documented a reduced number of new plague cases following implementation of his rat control and intensified sanitation activities [10]. When delegates from a conference of State and National Boards of Health reconvened in 4 June 1903, they were satisfied that California had undertaken vigorous antiplague measures and ruled against quarantine against California [39]. With no further cases, Blue’s antiplague campaign was terminated in April 1905 [10]. In total, plague claimed 121 lives (an additional 8 recovered). Plague spread from rats in California by fleas to the native animals that remain the reservoirs for plague in America today [6]. The victims were mainly Chinese, but the tally also included 10 whites. Although disease involved all corners of the city, most cases were concentrated in a 20-block area of Chinatown [5]. In January 1903, the Los Angeles Times stated, “If the plain truth were to have been admitted, and vigorous plague measures had been adopted, the disease would have been ‘wiped out’ a long time ago” [40].

CONCLUSION

By traveling to the site of an outbreak, Novy used his bacteriologic evidence to argue that there could be variations to the classic descriptions of plague by medical texts as a frightful ravage. By searching for and finding Bacillus pestis, Novy attempted to redefine a disease that had previously been characterized by its dramatic epidemiology (population decimation), its clinical features (buboes), its consequences for society (economic disruption and social disorder), and the manner in which it was apprehended (terror). In the early germ period, Novy used bacteriology to reformulate and enlarge the traditional imagery of a disease.

At issue in San Francisco in 1901 was who got to decide whether plague was present, what criteria could be used, and how consensus could be reached. This issue is relevant today for infectious disease physicians, particularly under circumstances when patient groups contest the testing used to diagnose diseases such as Lyme. Despite the wishes of Wyman, the evidence of disinterested bacteriologists would not preempt dissenting voices of other citizens in 1901, including practicing physicians, politicians, and Chinese living in Chinatown. Nor would the diagnosis of the eminent scientists be considered the most authoritative source of disease interpretations in all places and at all times. The bacteriologic findings of the university-based scientists were accepted and their conclusions acted upon only when they resonated with the overall financial, social, and political interests of the city—to avert the threatened trade embargo unless stringent antiplague measures were adopted.

Notes

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