

Chapter Fourteen

Yellow Fever Loses Its Mystique

In the late winter of 1900, yellow fever began making its rounds in Havana. Just a few weeks earlier, Major General Leonard Wood, one-time commander of the Rough Riders and commander of the Department of Santiago, had replaced General John R. Brooke as military governor of Cuba. Aggressive and energetic, Wood was a superb soldier and military administrator, and according to Teddy Roosevelt, a born diplomat. He was also a physician. Wood had first contended with yellow fever during his tenure in Santiago, where the disease seemed to thrive predominantly on American soldiers and citizens. Then he had quarantined the city, cleaned it from one end to the other, moved regiments to higher ground, and watched the fever disappear. When Wood put the same strenuous sanitary methods into effect in Havana, yellow jack continued to smolder among nonimmune Americans and struck hard at equally nonimmune Spanish laborers. Wood was baffled and apprised Sternberg of his dilemma and asked for a special commission to pursue the elusive etiology of yellow fever.¹

That Sternberg did not establish a Tropical Disease Board in Havana simultaneously with that in Manila is enigmatic. The facilities and manpower were already in place, and Cuba provided a plethora of endemic maladies suitable for study. Wood's request, which was timely for Sternberg, made it a moot point. Walter Reed and James Carroll had confirmed their preliminary experiments in regard to the nature of *Bacillus icteroides* and *Bacillus X* and sent them to press. The field of yellow fever research and treatment had advanced no further than when Sternberg had left it 10 years earlier; the military governor was specifically urging the resumption of that work, and it was predicted to be a severe yellow fever season in Cuba. Delighted at the prospect, Sternberg began hammering out the details for a Yellow Fever Board with Reed.²

Exactly what they discussed behind closed doors will never be known because no notes of the meetings survived, which is regrettable in light of later events that would alter the close professional relationship they had shared since 1893. Carlos

Finlay's mosquito transmission theory was discussed. Although Sternberg suggested Reed look for an intermediate host—as in malaria—and “give special attention to the possibility of transmission by some insect,” he did not believe it was a mosquito.³ More importantly, Sternberg was not suggesting the disease was transmitted by the bite of a mosquito or any other insect. He accepted the role of ticks and tsetse flies in transmitting Texas cattle fever and trypanosomiasis, respectively, but he was not convinced of the veracity of vector transmission in yellow fever. Sternberg considered the mosquito's relationship to yellow fever—if one existed—to be analogous to that of the fly in typhoid fever, and he still believed the intestinal tract was the most likely portal of entry for the infection. He also urged Reed to determine whether the disease could be transmitted from person to person through blood inoculations. In his formal instructions, he told Reed to take advantage of any opportunities to study other infectious diseases and gave detailed instructions concerning those maladies. By doing so, Sternberg watched for the unexpected and gave the Yellow Fever Board—at least officially—the flavor of the Tropical Disease Board in the Philippines. Sternberg made it clear to Reed that “the most important question which will occupy your attention is that which relates to the etiology” of yellow fever.⁴ In this regard, he did not “consider it necessary to give [Reed] any suggestions or detailed instructions.”⁵ What specific instructions could be given? The board was essentially starting its work from scratch. Sternberg had tremendous faith in the men he selected for his yellow fever think tank. Reed, Carroll, and Aristides Agramonte had been studying yellow fever in Washington and Cuba for the past 18 months. Jesse Lazear, a sharp bacteriologist who had been offered a contract by Sternberg upon the glowing recommendation of William Welch, had been performing superbly at the Camp Columbia hospital since February. After reporting to Wood, Reed was authorized to establish his headquarters at the Havana or Camp Columbia Laboratory and obtain whatever supplies were required from the depot in Havana.⁶

In the afternoon heat of June 25, the Yellow Fever Board gathered for the first time on the veranda of the officer's quarters at Camp Columbia and reviewed its general instructions. Since the work done disproving Giuseppe Sanarelli's claim had been conducted in Washington with older culture specimens, Reed felt the board was obligated to demonstrate the absence of *B icteroides* in fresh blood cultures and tissues of yellow fever victims. The board's work followed this line of investigation and continued to do so into July, but apparently Finlay's mosquito hypothesis was first discussed in earnest during the last week of June. Dr. Henry R. Carter, Chief of Quarantine Officers for the Marine Hospital Service in Havana, generated this discussion. In 1898, Carter had discovered that a consistent interval of two to three weeks between the index and secondary cases of yellow fever in two small Mississippi hamlets and became convinced this resulted from an intermediate host “analogous to the transmission of malaria.”⁷ In a note written to Lazear on June 26, Carter stated he believed “the argument from Dr. F's theory has much in its favor—to me it is more plausible although his observations as I have read them are not convincing, scarcely corroborative.”⁸ After reading Carter's paper on the Mississippi

study, Lazear was sufficiently convinced to recommend the board pursue this line of investigation. Reed acquiesced, and mosquito eggs were obtained from Finlay. Whether Reed was as convinced as Lazear and Carter at this date is uncertain, but Carroll and Agramonte were still unimpressed. But this old idea continued to bounce around in Reed's mind careening off of the studies of Ronald Ross and Carter and the fact that cases of disease in the American sector of Havana had traveled haphazardly, jumping houses and crossing streets, as if it moved through the air. The theory no longer seemed as ridiculous as it once had, but another event focused Reed's full attention upon it.⁹

In mid-July, Reed investigated eight deaths, initially reported as malarial fever, at the Pinar del Rio barracks. As he studied the outbreak, he suspected they were cases of yellow fever, and he made two astute observations. First, although no disinfection of linens or patient discharges had been done, none of the attending nurses, patients on the wards, or laundry personnel had become ill. Second, one of the deaths had been a prisoner in the stockade, making it impossible for him to have acquired the disease in town. Ironically, the diagnostic failure of the Pinar del Rio medical officers assisted in convincing Reed that Finlay's hypothesis had to be pursued to its natural conclusion.¹⁰

The decision to do so was not made lightly. No laboratory animal had been found to contract yellow fever, and, therefore, only through human experimentation could mosquito transmission be confirmed or denied. "Personally," Reed confided to Sternberg, "I feel that only...experimentation on human beings serve to clear the field for further effective work—with one or two points cleared up, we could then work to so much better advantage."¹¹ But the moral responsibility with such a venture weighed heavily on them as they discussed the various details inherent to this experimental approach. By August 1, the day Reed departed for Washington to assist Victor Vaughn in completing the final report of the Typhoid Board, it was agreed that lives sacrificed in the course of board's work would be justified by those saved following the establishment of the theory. All members of the board, with the exception of Agramonte who was immune, agreed to be bitten and accept the same risks as those they asked to volunteer. Sternberg, who supported their decision, had few qualms about human experimentation and was eager to conduct blood inoculations to test the transmissibility of yellow fever from one individual to another. As to using mosquitoes instead of hypodermic needles, Jefferson Kean commented years later, Sternberg was "entirely skeptical"¹² of the idea and quoted him as telling Reed, "You can try it if you want to, but there is nothing in it."¹³ Even so, Sternberg either ordered or strongly advised his most able lieutenant not to experiment on himself.¹⁴

Sternberg was not afforded the luxury of enjoying—even vicariously—the resumption of yellow fever research in Cuba. His focus and that of his military and medical colleagues in the Philippines was abruptly shifted to a new crisis in early June. In China, a xenophobic, grassroots revolt, led by a society known as the Boxers United in Righteousness, had erupted in the northern provinces. The Boxers blamed foreign interference in trade, politics, religion, and technology for all of

China's problems, and their goal was to rid their country of all foreigners. Their increasingly violent activities put the British, Belgian, French, German, Dutch, Russian, and American legations in Peking under siege by early June. Following an ill-fated relief expedition from Tientsin, European Naval squadrons established a secure base of operations against the Boxers at Taku. It was estimated that 60,000 troops—10,000 of which should be American—were needed to enter Peking. The War Department ordered General Arthur MacArthur to send troops to protect Americans in China and dispatched a composite force, commanded by Major General Adna R. Chaffee, from the United States to China.¹⁵

Sternberg prepared for an inspection tour of major western hospitals and medical supply depots as these events transpired. To ensure the relief expedition had the required medical support before departing Washington, he ordered Major and Surgeon William Stephenson to Manila to confirm what medical arrangements had been made with Greenleaf, and then report to Chaffee in Taku for duty as chief surgeon for the expedition. Sternberg gave Stephenson \$50,000 for hospital and medical expenditures and told him at least a 250-bed hospital should be provided. Greenleaf winced at this loss of manpower and materiel. He had lost three surgeons—20 hospital corpsmen, four ambulances, and a 50-bed regimental hospital—to the 9th Infantry, a fact apparently not known in the Surgeon General's Office (SGO). He also lost four additional medical officers, 26 hospital corpsmen, a 300-bed hospital, and supplies for 5,000 for three months when the 14th Infantry sailed. The pain was more than he could endure. He wired the surgeon general in mid-July that he could not "spare medical officers or Hospital Corps for field hospital. Need one hundred medical officers, three hundred Hospital Corps Philippine Islands."¹⁶ Twelve days later, MacArthur concurred with Greenleaf's assessment in a cable to Adjutant General Henry Corbin noting that "117 stations without medical officers something over 10,000 men with inadequate medical attendance a large number of which without attention at all."¹⁷

Sternberg returned to this flurry of communiqués on July 23. Greenleaf's outrageous request could be dealt with from the SGO, but MacArthur's concurrence required an immediate official response to the Corbin. The Army medical manpower issue in the Philippines had always been one of numbers and compensation. Supply had never met demand. Now, the crisis in China highlighted congressional dalliance in addressing the surgeon general's supply concerns and the increasing demand for medical personnel required by McKinley's pacification policy. Frustrated—and understandably somewhat defensive—Sternberg undoubtedly perceived the Medical Department was once again on the verge of being flogged for circumstances beyond its control. In two letters to Corbin, he explained his personnel problems concisely and put responsibility for decisive action where it belonged. The total number of hospital corps privates in service as of June 30, Sternberg explained, was 3,548, with 2,020 in the Philippines, 37 in China, and 95 en route with troops to Nagasaki, and 119 in training that required two months. "It is...impracticable...to comply with General MacArthur's request for 300 additional privates.... I respectfully invite attention...to the fact...he has the

authority to transfer enlisted men on duty under his command, from the line...to the Hospital Corps...The total number in the Hospital Corps from latest returns, including Hospital Stewards and Acting Hospital Stewards, is 4,189. There has been no definite limit fixed with reference to the number of Acting Hospital Stewards and privates, either by orders or by Act of Congress. I have therefore continued to authorize enlistments to meet the demands of the service, notwithstanding the fact...the appropriation made by Act of Congress for the current fiscal year will be insufficient to pay the number now in service.”¹⁸ Sternberg had given authority to recruiting officers and attending surgeons at larger posts to enlist men for the hospital corps without reference to the SGO. As to medical officers, the surgeon general noted that on April 30 there were 239 in the Philippines. “Since the first of April 100 additional contract surgeons and eleven commissioned medical officers have been ordered to Manila and I have endeavored to send out on every transport sailing from San Francisco from five to ten to replace those returning because of expiration of contract or sickness. By the Act of Congress...the number of contract surgeons is limited to four hundred eighty. There are at present...ten more than the number authorized by law. I respectfully request instructions as to whether this unexpected call for one hundred additional medical officers in Manila shall be filled by the employment of that number of contract surgeons, notwithstanding the provisions of the Act.”¹⁹ Sternberg also stated that immediate actions had been taken to provide the additional acting assistant surgeons requested, but in this regard invited Corbin’s attention to the fact that “Congress in its last session took no action upon my urgent recommendation for an increase of the Medical Corps of the Army, or upon the two bills which I forwarded for the benefit of acting assistant surgeons.... The result of this is...there is no inducement for the best of the contract surgeons to remain in the Philippines after their contracts expire, and a considerable number of them insist upon returning home [after one year].”²⁰ Sternberg also noted, in addition to the medical officers already supporting operations in China, five regular medical corps and 30 contract surgeons would be needed to assist them and at least 10 more to staff a base hospital in China or Japan. “It is therefore evident,” he concluded, “that to meet the requirements in Manila and China it will be necessary to employ under contract more than one hundred physicians in excess of the number provided for in the Act of Congress above referred to.”²¹

Sternberg’s comments and his demand for administration support were not lost on Corbin or Secretary of War Elihu Root. The following day, Root directed Corbin to send as many medical officers as could be spared to MacArthur and authorized “the employment of a sufficient number of contract surgeons to make up such deficiency in the number required to meet the present emergency.”²² Untied from congressional purse strings, Sternberg immediately advertised for the required number of physicians. In his reply to Root’s request for a summary of the distribution of Medical Department physicians and corpsmen the following week, Sternberg was gratified to report he had already received 1,000 applications. By the July 31, 407 medical officers—regular, volunteer, and contract—and 2,318 hospital corpsmen

were serving in the Philippines. He clarified for the senior leadership that not all physicians and corpsmen who supported MacArthur were in the Philippines. He noted that 10 medical officers and 142 hospital corpsmen assigned to Letterman General Hospital were completely engaged in caring for soldiers returned from the islands and should be considered as Eighth Corps assets, rather than in the pool of deployable medical personnel available in the United States.²³

As for the China Relief Expedition, Sternberg informed Root that 37 Medical Corps officers were in or en route to China. One hundred fifty members of the hospital corps were on their way to Taku from Manila and San Francisco, another 75 would sail on the steamer *Warren* in mid-August, and 39 were on the hospital ship *Relief*, now in Nagasaki Harbor. Three hundred seventy-five hospital beds with supplies for 5,000 men were available in China, and the *Relief* would soon provide another 250 beds. The surgeon general had also ensured that every command leaving San Francisco had a full complement of field medical equipment, including medical and surgical chests and folding field furniture, and a 50-bed field hospital had been attached to the 15th Infantry Regiment. Should these assets prove inadequate, he directed the medical supply officer in San Francisco to prepare a complete 1,000-bed field hospital for deployment to China upon request and another 500 beds and equipment—currently at Vancouver Barracks—shipped to Nagasaki to be used at the chief surgeon's discretion.²⁴

On July 13, a combined British, French, Japanese, and American task force had retaken Tientsin. On August 14, allied forces breached the gates of Peking. The Imperial City was secured the following day. Chaffee was extremely gratified with the performance of his command. More importantly for Sternberg and the Medical Department, Chaffee commented in his report to Corbin, "The medical department has provided as prompt relief to our wounded and as timely care of the sick as was possible to render.... I am informed...the hospital ship *Relief* arrived in Taku Bay not long ago and took on board a number of the wounded and sick from Tientsin."²⁵

Back in Washington, Sternberg enjoyed the success of his department in China. Chaffee was content, and no criticisms worthy of the name from self-actuated civilians or the press inundated his desk. It was also gratifying to have the support of a strong Secretary of War in resolving personnel issues. This allowed the surgeon general to focus on his concerns about how medical supply and personnel resources were being used in the Philippines and attempt to manage them more efficiently from Washington. To this end, he had half of the supplies requested for July through December sent as soon as practicable and the remaining half purchased in the usual manner by calling for proposals from suppliers. He scrutinized requisitions for hospital stores to ensure that all items were on the Medical Department's standardized supply table, and not items that the commissary department provided.²⁶

The surgeon general also became increasingly frustrated studying Greenleaf's request for, and returns of, medical officers during the year and compared them with officers deployed. Earlier in the year, Greenleaf had stated 360 physicians

were adequate, but in July, when he requested another 100 officers, there were 364 medical officers on duty in the islands. As Sternberg compared these returns against May hospital reports for Manila hospitals, he found a disturbing distribution of patients to medical officers and officers being inappropriately employed elsewhere.²⁷ "In my opinion," Sternberg wrote to Greenleaf in mid-August, "in view of the urgent need of medical officers elsewhere...it would have been entirely practicable to detach a considerable number of medical officers from the various hospitals in and about Manila. I would say, further, that I do not approve of the detail of a medical officer as assistant to the Supply Officer at Manila. In view of the great scarcity of commissioned medical officers...not more than two commissioned officers should be stationed at any General Hospital in the Philippines or elsewhere." Sternberg followed up these lectures to Greenleaf with a lengthy explanation of the same to the Secretary of War in which he concluded, "It appears to me...this number [of medical officers in Manila] is excessive in view of the deficiency reported elsewhere."²⁸

From Manila, Greenleaf did his best to comply with his chief's requests and educate him on the local situation. In response to the surgeon general's request for a report on the general medical condition of the troops, Greenleaf noted he was having difficulty obtaining timely reports from the southern stations. He estimated the total sick at 8.5 percent, but intestinal illnesses were increasing since the rainy season had begun. This is how he described his hospital situation: "There are no general hospitals in this Division, all being really field hospitals, but with local designations selected for convenience of administration: the sick are treated, first, in regimental hospitals, second, in 'military' hospitals, and third, in 'Manila hospitals.' The regimental hospital is in theory simply an emergency hospital, capable of expansion...as a rule they average a capacity of about ten beds, but there are instances where, owing to local sickness, it is increased to fifty beds. The 'military' hospitals are organizations segregated from regimental commands, and placed under the control of the Department Chief Surgeons; they are located at points convenient for either water or rail transportation, and are rather more elaborately equipped than regimental hospitals, from which they are intended to receive the over-flow; they vary in bed capacity from sixty to three hundred beds. The 'Manila hospitals' are all completely equipped, and vary from two hundred and fifty to one thousand bed capacity."²⁹ Greenleaf, however, continued to believe his chief was attempting to micromanage affairs he did not completely understand, and, therefore, replied rather indignantly to Sternberg's admonishment concerning doctor usage in Manila. "Referring to your criticism, in letter of 11th, on my assignment of medical officers to Manila hospitals," he wrote on September 23, "I must with all respect say that I do not think it is well grounded.... The field hospitals here must be equipped, in their personnel, on a basis of bed capacity and not bed occupancy, since this latter changes constantly.... It is my opinion that no ward doctor can do justice, under modern conditions of medical and surgical practice, to more than seventy-five patients, and here, where nearly all the cases are serious and the effect of the climate is debilitating, he should not be required to have more than

fifty patients under his charge; already a number of Manila Hospital doctors have broken down from overwork, and been sent home.”³⁰

For all of Sternberg’s medical and administrative knowledge, abilities, and experience, he had never managed a medical department in the field responsible for 60,000 soldiers. He understood the theory, but the difficulties encountered week to week and month to month by a medical department supporting counter-insurgency operations in the tropics were nearly impossible for him grasp. Time delays in correspondence aside, the surgeon general had no experiential context in which to place the information that Greenleaf supplied in abundance. One can speculate why Sternberg did not go to the Philippines in 1900—as he would do a year later—to sort out these issues face-to-face with his chief surgeon. Regrettably, no records have been found to clarify this question. Sternberg, however, continued to deploy medical officers because Greenleaf said he needed them desperately. Twelve commissioned and 12 contract physicians were on their way to Manila by mid-September to join those diverted to, and returning from, China. The surgeon general continued to struggle with MacArthur and Greenleaf over medical personnel and supplies as Aguinaldo escalated the insurgency in the fall of 1900. But as Greenleaf composed his reply to Sternberg’s criticism, a cable arrived in the SGO from Major Jefferson R. Kean in Quemados, Cuba: “Lazear yellow fever since 19th severe case much albumen, temperature high.”³¹ Sternberg ordered Kean to send daily reports on Lazear’s condition. On September 25, he wired Kean: “If Lazear is dangerously ill secure his notes relating to yellow fever experiments.”³²

During Reed’s absence Lazear allowed some of the mosquitoes he had been rearing for the past month to bite confirmed yellow fever patients, and then began applying them at two- to three-day intervals to volunteers who had not left the post. He also applied them to himself, but by the last week in August no cases had developed. As faith in the theory was waning, Carroll patiently coaxed a recalcitrant mosquito to feed on his own arm and four days later became horribly ill. Lazear and Agramonte were stunned; however, Carroll’s illness could not be proven to originate from the mosquito that bit him in the laboratory. On the same day his colleague was admitted to the hospital, Lazear found another willing volunteer, Private William H. Dean, 7th Cavalry, who had not been off post in nearly two months. When he became ill on September 5, the ominous reality of the situation struck them like a thunderclap. Further experimentation was halted and Reed was notified, but apparently not the surgeon general. Unfortunately, Lazear was bitten, possibly through his own negligence and a mistaken belief that he was immune, by a stray mosquito at Las Animas Hospital, and died in the evening of September 26.³³

A depressed Reed returned to Cuba on October 4 to a totally demoralized Yellow Fever Board. Details of the past weeks were discussed with Carroll and Agramonte, and Dean was interviewed at length concerning his movements after being released from the hospital. Only Dean’s case was confirmatory, and it convinced Reed that the mosquito did transmit yellow fever. Reed scrutinized the pages of Lazear’s laboratory notebooks for hours searching for data that would

explain the sudden success of these preliminary experiments. As he tabulated the experimental results, the picture came into focus: the difference was in the time interval between infection of the mosquito and human inoculation. Clearly, it was critical for the mosquito to feed on a severely ill patient early, but more importantly, the mosquito was not infective for at least 12 days afterward. This is what Carter had observed and why Finlay had failed. The mosquito—*Stegomyia fasciata* (*Aedes aegypti*)—was the intermediate host, the vector of yellow fever. Reed's characteristic slow, deliberate nature now gave way to a rush of activity. Sternberg was notified of his findings, and the report was prepared for publication. The results were inconclusive, but further experimentation had the potential to verify this preliminary analysis. Furthermore, ownership of the hypothesis had to be declared soon. For all of his prior derogatory comments concerning Finlay's theory, Sternberg had never seen Reed's scientific intuition or judgment fail. No chances could be taken even if he was wrong. Sternberg had Reed's paper added to the agenda of the annual American Public Health Association (APHA) meeting in Indianapolis on October 22, and then he convinced the editor of the *Philadelphia Medical Journal* to add the paper to the October issue.³⁴

Sternberg would have enjoyed the APHA meeting, but Philippine issues kept him in Washington. Greenleaf complained that 2,000 hospital corps privates were insufficient, and another 250 natives and ex-Spanish Army soldiers should be hired to work as litter bearers, kitchen police, and scavengers because these duties "cannot be performed by Americans."³⁵ The contracted workers were paid from the medical and hospital appropriation or from the public civil fund. Sternberg passed the funding request on to the Secretary of War. But, in regard to the hospital corps, he noted that his calculations indicated that 2,230 privates were already on duty in the Philippines, 48 were en route from the states, a large majority of the 195 were in China, and another 100 were scheduled to sail from New York in November. Once all of these medical privates arrived, they would comprise more than 4 percent of the command, and, after the expected return of volunteers late in the year, would exceed 5 percent, which is the amount Greenleaf had earlier estimated was appropriate. "In view of this," commented Sternberg, "and the fact...the number now in service is very much in excess of the number for which Congress has made appropriation, recruiting has been stopped for the present."³⁶ Moreover, Sternberg was still rankled over the organization of the Manila medical supply depot, a point never clarified by Greenleaf. Major Merritte W. Ireland was the overall officer-in-charge with First Lieutenants Powell C. Fautleroy and Benjamin J. Edger in charge of medical supply for the Departments of Northern and Southern Luzon, respectively. The surgeon general told Corbin the necessity for this detail escaped him, especially since medical officers were critically needed elsewhere. "It is not advisable to detail junior medical officers...for such duty, as they are liable to lose interest in their professional work and they are deprived of the opportunity for gaining professional experience. I therefore request...an investigation be made as to the necessity for maintaining branch supply depots...in...Manila."³⁷

For all of his good intentions, Sternberg was again meddling in operations that were beyond his understanding, and, while the investigation proceeded quickly, it was poorly timed. Aguinaldo's guerillas were making one last push to influence the November U.S. presidential elections. Attacks on isolated posts, detachments, and supply trains had increased in late summer and did not fade away until the end of November. MacArthur had little patience for the surgeon general's request because he was contending with these attacks and planning a counteroffensive to begin as the monsoon season dissipated, also in November. In a short reply to Corbin, MacArthur lambasted the centrally organized quartermaster, commissary, and medical supply depots as intolerable business propositions for his scattered forces and on the verge of total collapse until he had decentralized them—to the benefit of all. He concluded by commenting, "The Medical Department has derived incalculable advantages from the change, and the administration is now conducted with precision and to my entire satisfaction. This state of things will be interrupted if not entirely broken down if the views of the Surgeon General are to prevail."³⁸

Reed arrived in Indianapolis for the APHA meeting well before Sternberg received word that he had lost the battle with the commander in the Philippines. Reed's carefully crafted remarks easily consumed the 20 minutes allotted for him and another 20 were generously granted. But the polite applause he received could not mask the indifference with which the audience received what was truly a stunning revelation. The response from Indianapolis and New York papers was equally bland, and the *Washington Post* declared the mosquito theory "the silliest beyond compare."³⁹ A disappointed Reed returned to Washington, visited briefly with Sternberg and the recovering Carroll, and packed for the return voyage to Cuba.⁴⁰

Comments and concerns among contemporaries and historians have cast doubt on Sternberg's support of—and intentions toward—Reed's work.⁴¹ Sternberg obviously believed Reed's intuition had been correct and must be pursued. Otherwise he would not have pushed to have Reed added to the APHA agenda nor spent the time to convince the editor of the *Philadelphia Medical Journal* that the paper had merit. The paper did go to press quickly, but the corrections—clarifying informed consent issues—that greatly concerned Reed were made. Reed also suggested the last conclusion should merely state the mosquito served as the intermediate host for yellow fever. However, Sternberg disagreed and sent it forward as originally written: "The mosquito serves as the intermediate host for the parasite of yellow fever, and it is highly probable that the disease is only propagated through the bite of this insect."⁴² In November, he had reprints sent to a number of scientists around the world who would find it of interest. He also approved Kean's suggestions to use mosquito bars in all barracks and hospitals as well as in the field when practicable and to begin mosquito control measures on post. These did not seem like the actions of a doubting man. Moreover, he sent Reed the following note in November, "I am glad to know you are in a fair way to carry on additional inoculation experiments. As I said to you when you were in Washington, I consider this the most important matter for the present. The profession generally will not be disposed to accept the experiments already published as definitely settling the

question as to the role of the mosquito.... When this is once settled beyond question, it will not be so essential that you should demonstrate the presence of the parasite either in the blood of patients or in the bodies of mosquitoes, although of course this will be extremely desirable and is naturally the next step to be taken.”⁴³

Even so, Sternberg was justifiably upset with the conduct of the experimentation. The methods of the board appeared haphazard and uncontrolled, caused the death of one man and nearly killed another, and in the end gave inconclusive results. Moreover, he was disappointed in four scientists whom he knew possessed all the requisite skills and knowledge to preclude such a travesty. The events of August and September argue against any suggestion that, as of August 1, Reed or the board had any faith in the validity of Finlay and Carter’s theories. Truby was probably correct in his assertion that no member of the board “...had any expectation of meeting with the sudden success which resulted from Lazear’s preliminary experiments. Otherwise, Reed would have either delayed the mosquito work or had his trip to the United States postponed.”⁴⁴ Sternberg’s continued support of Reed and the Yellow Fever Board suggests he felt the same way. However, in early November, he sent this short dispatch concerning the August experiments to the *British Medical Journal*: “Unfortunately the mode in which the experiments were conducted detracts much from their value. They are really by no means conclusive. The experimenters themselves are of the same opinion. At most they are suggestive. It is to be regretted that, considering the great danger to which the subjects of these experiments were exposed, greater care was not exercised that the conditions of the experiments were absolutely free from objection.... Dr. Lazear’s life has not been thrown away if these experiments lead...to their repetition under more rigid conditions....”⁴⁵ This was written, presumably, to demonstrate publicly to an international scientific audience that the Medical Department was being totally objective in its work, but determined to continue further investigations. A proud and sensitive man, Reed’s vanity as a scientist rivaled Sternberg’s. Although he had undoubtedly heard similar words behind closed doors and could not object to their validity, he may have interpreted them as a public rebuke.

Before leaving Cuba in October, Reed obtained Wood’s approval—and financial and diplomatic support—to pursue further investigations. An experimental station named Camp Lazear consisting of two frame buildings and seven floored hospital tents, was erected in a mere two weeks. Reed’s experimental plan consisted of four simple, yet elegant, phases:

1. verification of disease transmission from the bite of infected mosquitoes,
2. verification of disease transmission from exposure to clothing contaminated with discharges from yellow fever patients,
3. a demonstration to show a home cannot be considered infected without the mosquito’s presence, and
4. determination of disease transmission from yellow fever patients to nonimmunes via blood injections.

Volunteers for these experiments came from the American and Spanish nonimmune communities. Reed carefully prepared a contract, the world's first consent form printed in English and Spanish, describing the grave dangers involved. Conflict of interest precluded him from asking for volunteers among the medical staff and hospital corpsmen at Columbia Barracks. However, to his surprise and gratification, a number of these men rose to the challenge on their own.⁴⁶

Phase I testing began on November 20. Private John R. Kissinger developed all the symptoms of yellow fever on December 8. As his fever soared, so did Reed's confidence. "Rejoice with me, sweetheart," Reed wrote to his wife, Emilie, "...aside from the antitoxin of diphtheria and Koch's discovery of the tubercle bacillus, it will be regarded as the most important piece of work, scientifically, during the 19th century.... It was Finlay's theory, and he deserves great credit for having suggested it, but he did nothing to prove it; it was rejected by all, including General Sternberg."⁴⁷ Two days later, he wrote to her again, still piqued that some of his colleagues would not recognize what was becoming—more and more—a discovery belonging solely to Reed: "The case is as plain as a nose on a man's face, but Dr. Guiteras has pronounced...our theory as being 'very wild and improbable'.... Six months ago, when we landed on this Island, absolutely nothing was known concerning the propagation and spread of yellow fever...but, today...its mode of propagation [was] established...."⁴⁸ In the same letter, he also wrote, "I will write Dr. Sternberg in a few days about the case—of course, he will, at once, write an article & say that for 20 years he has considered the mosquito as the most probable cause of yellow fever — That would be just in order for him to do so."⁴⁹

Ego notwithstanding, time and truth were on Reed's side. By December 15, three of the Spanish volunteers had developed confirmed cases. Furthermore, two weeks earlier, Dr. Cooke and Privates Levi Folk and Warren Jernigan had initiated phase II of the experiments in the infected clothing building. There, they had unpacked a number of boxes filled with clothing and bed linens soiled with the discharges of yellow fever patients, donned the clothing, prepared their beds, and hung the remaining malodorous rags about their quarters before retiring each night. They continued this repulsive ceremony for 20 days, but suffered only nausea as a result.⁵⁰

Reed contacted Sternberg with results of their success in the first two phases. He was convinced they had proven the theory—although phases III and IV had not been started—and suggested they prepare a supplementary note to be presented to the Pan-American Medical Congress to be held in February. Then he inquired of Sternberg, "...whether you consider it necessary that we should try blood injections.... Any other suggestions that you may make, will be much appreciated."⁵¹ Two days later, he wrote to his chief of the fourth case and his intent to begin phase IV.

Sternberg's initial response, "I congratulate you," received the following day, was curt, unemotional, and probably did more to deflate Reed's ego and engender bitter feelings than all the doubting colleagues and hostile press reports combined.⁵² Reed expected and needed more applause from his boss, but he could not have

been surprised. When it came to science, Sternberg remained objective until all the evidence was in; only to Mrs. Sternberg were his emotions revealed. Reed had worked with him long enough to understand that. The surgeon general wrote to him again on December 19: "I was very much pleased to receive your telegrams and your letter of December 14th and congratulate you upon the success of your experiments. Now if you can identify the parasite the question of etiology will to a great extent be settled. With reference to inoculations with blood...I think it would be desirable to make some experiments. The question is still open as to whether the parasite must pass through the body of a mosquito in order to infect susceptible individuals. If it is in the blood of patients in such a stage of development that the disease can be transmitted by inoculating small quantities of blood, then I see no good reason why the contents of the intestine should not also contain the germ as disorganized blood is always present in fatal cases. Having proved... the disease may be transmitted by mosquitoes there is little reason to doubt...this is the usual way in which it is transmitted; but we should not hastily conclude... it is the only way."⁵³ However, he agreed completely that Reed should present the results to the Pan-American Medical Congress.⁵⁴

Phase III of the experiments began just before Christmas with the release of 15 mosquitoes into one section of the infected mosquito building. Of these, only one—infected for 24 days—was capable of transmitting disease and three others—infected for 12 days—were considered possible vectors. John Moran, courageously accepting the challenge once more, was bitten repeatedly on the face and hands in three exposures of 30 minutes each while two nonimmune volunteers occupied the mosquito-free section. On Christmas day, Moran developed a confirmed case of yellow fever from which he subsequently recovered; the volunteers remained disease free. Reed again wrote Emilie of their success and commented rather smugly: "It will be as hard for Gen. Sternberg to give up the infected clothing theory as anyone else, for he has in his various writings espoused it as one of the facts that were well established! But we have already knocked this theory to simple Smithereens!"⁵⁵

Blood inoculations constituting phase IV followed in early January. Four individuals received injections of blood taken from patients in the first or second day of illness and three developed yellow fever. Directed by Reed's genius, supported by Sternberg and Wood, and assisted by a host of intrepid American and Spanish volunteers, the Yellow Fever Board had unequivocally demonstrated that the mosquito transmits yellow fever. Remarkably, this had been accomplished with no fatalities. Reed presented the work to the Pan-American Medical Congress in Havana on February 4. The convention hall was packed with physicians from North and South America, Cuba, Spain, and Mexico eager to hear of the experiments and not only applaud Reed, but also Carroll, Agramonte, and Finlay. Some vocal detractors were present, but as he told Emilie, "It was...a signal triumph of our work."⁵⁶

The first few weeks of 1901 were full of promise and optimism. MacArthur's fall campaign had focused on separating Filipino insurgents from their clandestine supply bases. Although anti-imperialist critics declared his methods nothing more

than a repetition of Spanish reconcentrado in Cuba, the quality of life in these towns improved. Resistance collapsed in Central Luzon by early February—which MacArthur heralded with gusto—and although Aguinaldo would not be captured until the end of March, the insurgency began to topple like dominoes throughout the archipelago. McKinley, who was buoyant over MacArthur's success, told Taft that he and his commissioners would soon take over from the military government.⁵⁷

With peace around the corner, Congress debated the proper size for the army and its medical support now engaged in civil–military operations on a global scale. Congress settled on a regular army of between 59,131 and 100,000 officers and men in early February—a legislative victory for Root—that increased regular infantry regiments from 25 to 30 and regular cavalry regiments from 10 to 15, but did not settle on a fixed strength of 77,287 enlisted soldiers until May. Sternberg's lobbying efforts were not so well rewarded by the 56th Congress. They fixed the strength of regular medical officers at 321, an increase of only 129 positions; gave the president authority to appoint 200 surgeons and assistant surgeons of U.S. volunteers to serve in the Philippines for two years; and provided for an additional 100 hospital steward positions—for a total of 300—to replace those lost as volunteer regiments returned to the states. Considering that 146 posts were in the United States, Cuba, and Puerto Rico; 438 posts were in the Philippines; seven arsenals were in the United States and six general hospitals in the United States, Hawaii, and Japan; and facilities were still functioning in China, as well as administrative positions in the SGO, Library, and Army Medical Museum; these additions were a pittance. In this same military appropriations bill, however, Congress did approve the organization of a permanent Army Nurse Corps and a Dental Corps of 30 contract dentists.⁵⁸

Sternberg recognized that whatever the fixed strength of the army would be, it would definitely be larger than its pre-1898 level and its mission tremendously more complex. Naturally, a proportional permanent expansion of the Medical Department would follow with a concomitant increase in the complexity of medical operations. Although he could not discern the future, Sternberg could clearly comprehend the past. War, national expansion, advances in medical science, and changing clinical practices had forever altered the composition and role of the Medical Department. Hospital ships, field laboratories, hospital corpsmen, nurses, and now dentists were fast becoming permanent fixtures in the department's inventory. Indeed, the hospital corpsman had become second only to the medical officer, a most indispensable asset on Cuba's battlefields, in the Philippine jungles, on the hospital and hospital ship wards, and in the laboratories. The success of future operations depended on their services, and the surgeon general focused considerable attention on the requirements of this corps in early 1901.⁵⁹

In preparation for congressional questions concerning the size of the hospital corps, Sternberg queried his departmental surgeons on the number of commissioned officers and enlisted personnel required to staff hospitals of 100 to 1,000 beds based on the theory that all work at the facility was done by the hospital corps. The table generated from the data received gave a steady medical officer to enlisted ratio of one-to-seven and reflected the labor-intensive operations of larger

general hospitals. The numbers supported the conclusion that a hospital corps comprising 4 percent of the total projected army strength was sufficient. However, Sternberg cautioned that if the corps was to meet the sanitary needs of the Porto Rican Provisional Regiment and the 13,000 native troops in the Philippines, then its total strength could not be less than 3,800 men or 5 percent of the total fixed strength estimated.⁶⁰

To meet current requirements, Sternberg had resumed hospital corps recruitment in January. Difficulties in recruiting and training desirable men, which had always been a problem, had intensified during the Philippine conflict. Large numbers of corpsmen had been brought into service often without basic knowledge of reading and arithmetic. Medical instruction was truncated in an effort to get corpsmen into theater with the hope they would obtain the rest of their education while on the job, a hope that frequently went unrequited. Sternberg began to address these issues with his usual methodical approach. Surgeons at Forts Columbus, Sheridan, Snelling, Leavenworth, Sam Houston, Logan, and Vancouver Barracks were directed to reestablish instruction detachments, which had been disrupted by the war. Pleased with the success of departmental surgeons in shouldering recruiting, instruction, and disciplinary actions of corpsmen in the United States, he implemented this program armywide in conjunction with a systematic course of instruction—five hours per week with a detailed report to accompany monthly returns—at every post. These three changes put greater responsibilities on departmental and post surgeons than they were used to and familiar with. Moreover, it required more experienced manpower than the army had, and it was on this point that Sternberg encountered resistance. Greenleaf, virtually the godfather of the hospital corps, was not optimistic about the creation of a systematic course of instruction at every post, commenting, “it must be remembered...more than eighty percent of the medical officers serving in this Division are to a greater or less extent untrained...their stations frequently changed, and very few of the acting assistant surgeons are sufficiently familiar with their military duties to be capable of instructing members of the Hospital Corps, except in methods of first aid...in a majority of instances the members of the Hospital Corps are more familiar with their military duties than is the doctor.”⁶¹ From the Department of California, Deputy Surgeon General Henry Forwood was in the main supportive, but noted “At a general hospital, where the work is arduous and the number of corps men barely sufficient, it cannot be put into complete operation without detriment to the service....”⁶² Majors George Torney, at the Army and Navy General Hospital, and Valery Havard, in the Department of Cuba, thought the idea workable, but Major William B. Bannister, recently posted to West Point after returning from China, declared such an enterprise was impossible at the academy due to the distance between the post’s two hospitals.⁶³ Nevertheless, the surgeon general held to his standards; but, over the next year, the instructional report fell from a “monthly” to an “occasional” requirement, and Sternberg’s comment in his annual report that “the instructional work of the various posts has generally been well done” suggests the reality was rather less than he had desired.⁶⁴

In Cuba, the practical application of Reed's triumph also began in early 1901. Initially unfamiliar with the mosquito life cycle, William Gorgas and Reed felt that destroying sufficient numbers of adult mosquitoes to preclude outbreaks of disease would be impossible. After further thought and many discussions, Reed, Gorgas, and Sanitary Department members "decided that we should adopt all measures that seemed likely to be useful..."⁶⁵ These measures included screened yellow fever isolation wards, fumigation of homes and buildings with pyrethrum powder and kerosene, and destruction of breeding sites. In just a few weeks, Gorgas noticed a decline in yellow fever cases around Havana. Much to everyone's surprise, he hesitated to accept the board's conclusions completely and was not ready to dispense with the expensive, yet comforting, disinfection procedure. Wood and others in Havana were perplexed. Although he never pinched pennies in the fight against yellow fever, Wood did not like to see them frittered away either, and he asked Sternberg to adjudicate the matter. According to Valery Havard, Sternberg replied immediately and "with full conviction that, after the experiments of the Reed Commission, doubt was no longer possible..." Circular No. 5 was published in late April—sans disinfection—but Gorgas would continue the practice until August.⁶⁶

It was assumed by medical experts that a mosquito that had bitten a mild case of yellow fever would transmit the same mild case. Therefore, vaccination with mosquitoes infected from mild cases was considered a possible method to establish lifelong immunity. Gorgas told Sternberg at the end of February that he had established "a small experimental station under the care of Dr. Guiteras, where I am carrying on experiments on the line of Reed's work, to see if some general system of inoculation would not be feasible and justified."⁶⁷ In doing so, Gorgas assumed command authority and scientific responsibility that he did not have. Interestingly enough, Sternberg and Wood allowed the experiments to proceed, an indication that methods for controlling new science and research in the Medical Department were yet to be established. Cool weather and apparently ineffective laboratory technique precluded captive mosquitoes from becoming infected. With a single exception, the first 29 attempts failed to produce disease, but this would change dramatically in August.⁶⁸

In March, General and Mrs. Sternberg moved from 16th Street, NW, to 1440 M Street, NW, just a few days after sitting through President William McKinley's second inauguration. McKinley came to his second term on a great wave of popular approval. He was eager to see this large electorate, speak to them about important issues facing the nation, and have them see and hear their president in person. Therefore, he determined his first public action would be a grand tour of the nation that would end in Buffalo on June 13 for the President's Day celebration at the Pan-American Exhibition. Before leaving on this six-week excursion, he reviewed the preparations for the U.S.-directed civil government in the Philippines. A large amount of revision, fine tuning, and adjustment of organizations and agencies would be required as the military gave way to civilian control. Presidential decisions concerning the archipelago had to be based on current and accurate data and gathered by men McKinley could trust. With this in mind, he

directed the War Department to organize and conduct an inspection tour of the islands. While Inspector General Joseph C. Breckinridge dispatched Colonel Joseph P. Sanger on a comprehensive tour of U.S. assets, which included the Medical Department, in Asia in late March, Corbin planned a follow-on inspection by the bureau chiefs in the summer.⁶⁹

The SGO hummed with activity that spring. Sternberg planned his Philippine agenda, prepared Forwood to conduct official business during his absence, and planned for the reopening of the Army Medical School. He addressed the American Social Science Association on the recent advancements in understanding yellow fever, and he wrote an article on mosquito transmission of that disease. Mrs. Dita H. Kinney settled in as the first superintendent of the Nurse Corps. Much to the surgeon general's delight and satisfaction, Reed had returned from Cuba. In mid-May, Mrs. McKinley was seriously ill secondary to an abscessed thumb. She returned immediately to Washington, and although she weathered the crisis her devoted husband requested Sternberg continue his regular visits and provide medical advice. Upon the completion of one of these visits, the two men discussed Sternberg's upcoming trip to the Philippines, and McKinley asked if Mrs. Sternberg was to accompany him. The surgeon general said she would not accompany him because she was planning to spend that time with her mother in Indianapolis. Having nearly lost his beloved Ida so recently, this reply disturbed the president tremendously. He urged Mrs. Sternberg to come and see him—which she did—and by the time she left the White House had determined to sail for the Philippines in June.⁷⁰

With Forwood, Charles Alden, Kinney, and Reed supervising the SGO, Sternberg boarded the California Limited, bound for Los Angeles via Chicago, on June 18 in complete confidence that Medical Department business would proceed as he expected. By the time he returned, the medical school would be ready to accept the class of 1902, and Reed and Carroll might have some new knowledge of the yellow fever germ based on their blood work and examination of infected mosquitoes. Sternberg had commented after his exhaustive researches years before of "the possibility...the specific infectious agent...may belong to an entirely different class of micro-organisms from the bacteria, or that it may be ultramicroscopic, not capable of demonstration in the tissues by the staining methods usually employed..."⁷¹ With Sternberg's hunch and a suggestion from long-time friend and mentor, William H. Welch, to consider pursuing the techniques that led Friedrich Loeffler and Paul Frosch to demonstrate the ultramicroscopic character of the agent of hoof and mouth disease in Germany, Reed had Carroll plan a return to Cuba in August to conduct another series of experiments.⁷²

Regrettably, Reed perceived Sternberg was claiming more and more credit for the results of the Yellow Fever Board, a suspicion that had begun to germinate in his December 9 letter to Emilie.⁷³ Sternberg's article, "The Transmission of Yellow Fever by Mosquitoes," which was published in the July 1901 issue of *Popular Science Monthly*, did nothing to allay Reed's growing paranoia. After a short recapitulation of modern yellow fever investigations, the paper described the work done by the Yellow Fever Board explicitly and gave appropriate credit. Sternberg

prefaced his presentation of the board's work by stating, "Having for some years given much thought to this subject, I became some time since impressed with the view that probably yellow fever, as in the malarial fevers, there is an 'intermediate host.' I therefore suggested to Dr. Reed...that he should give special attention to the possibility of transmission by some insect, although the experiments of Finlay seemed to show...this insect was not a mosquito of the genus *Culex*, such as he had used in his inoculation experiments. I also urged that efforts should be made to ascertain definitely whether the disease can be communicated from man to man by blood inoculations."⁷⁴ These comments infuriated Reed, and he quickly made his displeasure known to Gorgas in Havana: "You might tell Dr. Finlay...with my best compliments...he had better look to his laurels as the proposer of the Mosquito Theory, since Dr. Sternberg...puts forward his name very conspicuously for the credit for our work in Cuba. Dr. Finlay's turn will come. You must get it and read it. It says, as you will see, that 'having given the subject thought for many years sometime since (!) became impressed with the idea that yellow fever, like malarial fevers, was due to an intermediate host! I therefore suggested to Dr. Reed...to give special attention to the possibility of transmission by some insect!' The ungodly ___. What can our chief be thinking of to deliberately and grossly misrepresent the facts! Can he believe, for one moment, that he can hoodwink sensible men! Remember, my dear Gorgas...I have yet to hear one word of praise from Sternberg! This is the reward for our work in Cuba! He...only mentioned Finlay's theory to condemn it! and now, after the work has been done, he not only is willing to undertake to rob the living, but even the dead of their just reward!...I wish that you would show this to Havard.... You can both judge the motive of our Chief in doing so despicable a thing...."⁷⁵

Again, Reed partisans have cited this essay and letter as evidence that Sternberg unjustly took credit for the board's work to reflect glory upon himself.⁷⁶ However, when the *Popular Science Monthly* article, Reed's letter to Gorgas, Sternberg's instructions to the board, and some of his previous writings are examined together, Reed's self-righteous anger and indignation do not have a completely honest ring. Sternberg stated his ideas concerning vector transmission of infectious diseases to the New York Academy of Medicine in 1895: "There is a way which pathogenic bacteria may be carried a limited distance through the air, and by which infectious material may be conveyed from house...privy-vault to...beefsteak upon the...table or into the milk-jug, which should not be lost sight of in considering channels of infection. This is upon the feet of insects, and especially of house-flies, which...frequent...decomposing animal material and swarm upon the surface of fecal matter deposited upon the surface of the ground or in shallow pits. There are many facts which support the view that such material affords a suitable nidus for the development of the yellow-fever germ, and I am strongly inclined to believe that the...house-fly is a factor of considerable importance in the propagation of yellow fever, typhoid fever, and cholera. Dr. Finlay...some years ago conceived the idea that yellow fever is transmitted from the sick to susceptible individuals by mosquitoes; but his experiments do not give any support to his theory.... It has also

been suggested...the mosquito may give rise to malarial infection, by introducing the malarial germ through the puncture it makes for the purpose of obtaining the blood of its victim. But I know of no exact observations or experimental evidence in support of this hypothesis. There are, however, some reasons for believing...the mosquito may play a part in the etiology of malaria in the way suggested by Manson.... The transmission of infectious diseases by insects appears to be well established [for] the Texas fever of cattle and...the fatal African epizootic known as the "fly-disease" [African trypanosomiasis]. In the first mentioned disease...the tick is the intermediate host.... After feeding on the blood of an infected animal the tsetse-fly can communicate the disease to a healthy animal by its bite."⁷⁷ In February 1898, he wrote this to Stanford Chaille: "There is every reason to believe that in yellow fever...the infectious agent is...in the excreta of the sick.... One method in which the infectious agent may be transported from the sick room...to a favorable nidus for its external development is by means of flies; I am disposed to believe...they constitute a very important factor in the propagation of disease."⁷⁸

Clearly, Sternberg had been considering the role of intermediate hosts in disease transmission. He was impressed that the transmission of malaria might occur as Manson had described, and that yellow fever might be transmitted in the manner of typhoid fever. These opinions had not changed by 1900. Reed undoubtedly was familiar with Sternberg's opinions and, therefore, his indignation must reside in Sternberg's claim to have suggested looking for an intermediate insect host in Cuba. In his official instructions to the board, Sternberg stated he had no specific suggestions or directives upon which it should act. If the suggestion was made—something that will never be known—it must have been presented to Reed alone in one of their early meetings in May 1900. However, Sternberg never intimated publicly—before or after the yellow fever board's investigations—that he had seriously considered the mosquito or its bite to be a possible—or even likely—method of transmission.

The animus Reed perceived in Sternberg's actions during the yellow fever investigations and his sense of being under-appreciated by his mentor and chief did not spring from his mind *de novo* in Cuba. They developed through years of successful, yet laborious, scientific and administrative work for a man who was thoroughly objective in his approach to science and the army, and extremely unemotional in expressing his gratitude for a job well done. Sternberg did let Reed know he was appreciated, but not enough to support Reed's ego. Of course, Sternberg bears a great deal of responsibility for the creation of Reed's self-esteem. He handpicked and molded the fledgling bacteriologist in his own image—ego and all. If Sternberg was ever aware of Reed's true feelings, he never let it become public; if Mrs. Sternberg knew, she took the secret to her grave. Reed never made them public either.

The army transport *General Hancock* sailed by the northern route for a more rapid transit. Entering Manila Bay, the ship passed the imposing island of Corregidor rising some 600 feet above the sea, the old naval station at Cavite, the remnants of the Spanish Fleet, rusting monuments to Dewey's victory, and then dropped

anchor some distance off shore. A launch soon arrived carrying Chaffee and his staff to officially welcome Corbin and his staff, Quartermaster General Marshall I. Ludington, Commissary General John F. Weston, Chief of the Signal Corps General Adolphus W. Greely, and the Sternbergs. As the inspection party was preparing to go ashore to a Manila hotel, another launch, from the hospital ship *Relief*, also came alongside. The commander of the hospital ship, Major and Surgeon Harry O. Perley, climbed aboard the transport, warmly welcomed General and Mrs. Sternberg, and quietly urged them to stay aboard the *Relief*, rather than trust the doubtful accommodations in town.⁷⁹

Aboard the *Relief*, Sternberg met with Lieutenant Colonel Benjamin F. Pope, who had replaced Greenleaf as chief surgeon in May, Perley, and other medical officers to discuss his inspection requirements and plan a travel agenda. The surgeon general found his officers upbeat and enthusiastic. The waning insurgency had significantly reduced the intensity of medical operations and the attendant stress and anxiety that accompanied them. Consumption of medical materiel had slowed, hospital beds were unfilled, and, as commands were consolidated, posts abandoned, and troops sent home, medical personnel began to enjoy a relative, momentary increase in their numbers. Sternberg's inspection began with a tour of the *Relief*, and over the next few days he focused on the larger hospitals on Corregidor, at Dagupan, and in Manila. All agreed the services of the faithful hospital ship were no longer needed. Moreover, it was tremendously expensive to operate, and Sternberg decided earlier to give it over to the Quartermaster Department for use as an inter-island transport. The hospitals, which were fixed facilities on hardstand, functioned satisfactorily from a medical standpoint, but needed repair, as well as some of their sterilizers, water distilling plants, and ice machines. Captain Merritte Ireland, who was in charge of the medical supply depot in Manila, presented warehouses to Sternberg that had stocks to last a year.⁸⁰

In the last week of July, the Sternbergs joined Corbin and other officers in a tour of the southern islands that included stops at Iloilo, Cebu, Zamboanga, and Jolo. The difficulties of distance, terrain, and climate experienced by his surgeons on a daily basis, and described earlier by Henry Lippincott, Alfred Woodhull, and Charles Greenleaf became clear as he navigated steep and narrow trails from one station hospital to another. These hospitals—many just crude nipa shacks—were small and needed repair, but inside Sternberg was gratified to find that medical care, whether delivered by a physician or corpsman, met a standard of which the Medical Department could be proud. The overall health of the army was satisfactory, an indication medical and line officers were adhering to Medical Department directives on field sanitation and hygiene.⁸¹

Upon returning to Manila, the surgeon general cabled Forwood that \$20,000 worth of appropriations were needed for hospital construction and repair, and he was not to make any medical supply purchases in the fall. "The supply depots are loaded up with supplies of all kinds, and we are not likely to have any requisitions for a long time to come,"⁸² Sternberg told Forwood, and "The supply depots at home are also full...in expectation that large requisitions would be received from

the Philippines. In view of the large amounts on hand...I expect to cut down our estimate for the Medical and Hospital appropriation to one million dollars."⁸³ He also initiated the consolidation of many hospitals and medical storage depots, and designated a handful of medical officers for redeployment to the states.⁸⁴

Before leaving the Philippines, the surgeon general had one more mission to accomplish, this one at Root's direction. Suggestions for establishing a center for the rest and relaxation of officers and soldiers suffering from the ill effects of the tropical climate on a mountaintop near Baguio had filtered their way to Root's desk. He requested Sternberg personally investigate the area and comment on the practicality of such an undertaking. In mid-August, Sternberg took a train to northern Luzon once again. At Dagupan, Sternberg mounted a horse and followed a guide the last 30 miles—through jungle and up rugged trails—into the Central Mountains of Benguet Province. At 5,000 feet, the small party rode onto a grassy plateau dotted with pine and oak trees. Sternberg thought it was a beautiful location for a health resort, but building a wagon road, let alone a railroad, into the area would be expensive. Even so, he recommended the spot to Root, and in the coming years a health resort and convalescent home was established there.⁸⁵

Seven weeks after anchoring in Manila Bay, the Sternbergs settled into their rooms aboard the army transport *Thomas* for their voyage home. Their stay in the Philippines had been an extremely pleasant adventure and, although eager to get home, they looked forward to the scheduled stops in Japan. As the steamer made its way north along the western coast of Luzon, Sternberg's mind undoubtedly turned to the yellow fever experiments being done by Reed and Carroll on the other side of the world.⁸⁶

Carroll had arrived in Havana to begin his work at Las Animas Hospital just as Gorgas' inoculation experiments culminated in disaster in August. Sixteen individuals were bitten by infected mosquitoes. Of these, eight developed disease, several with severe symptoms, and three died, one of which was Miss Clara Maas, an American volunteer nurse at Las Animas Hospital. These events demonstrated the unpredictable lethality of mosquitoes infected with yellow fever and, thereby, the futility of inoculation as a preventive measure. This obvious risk notwithstanding, volunteers stepped forward to assist Carroll with his work. Two volunteers developed yellow fever after inoculation with infected mosquitoes. In the third day of illness, Carroll withdrew blood from one of these volunteers, divided it into three aliquots, and then began the planned experiments. One portion of blood was injected into another volunteer, a second was passed through a Berkefeld filter and then injected into a second volunteer, and the third portion was heated to 55°C for 10 minutes and then injected into three other volunteers. The first and second volunteers developed yellow fever and recovered, but the other three remained healthy. Carroll's demonstration of the ultramicroscopic and heat-sensitive nature of the yellow fever agent concluded the work of the Yellow Fever Board with a flourish. Reed and his colleagues had taken medical science one more step forward.⁸⁷

