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Vaccine Production in the Bitterroot Valley during World War II: How Rocky Mountain Laboratory Protected American Forces from Yellow Fever
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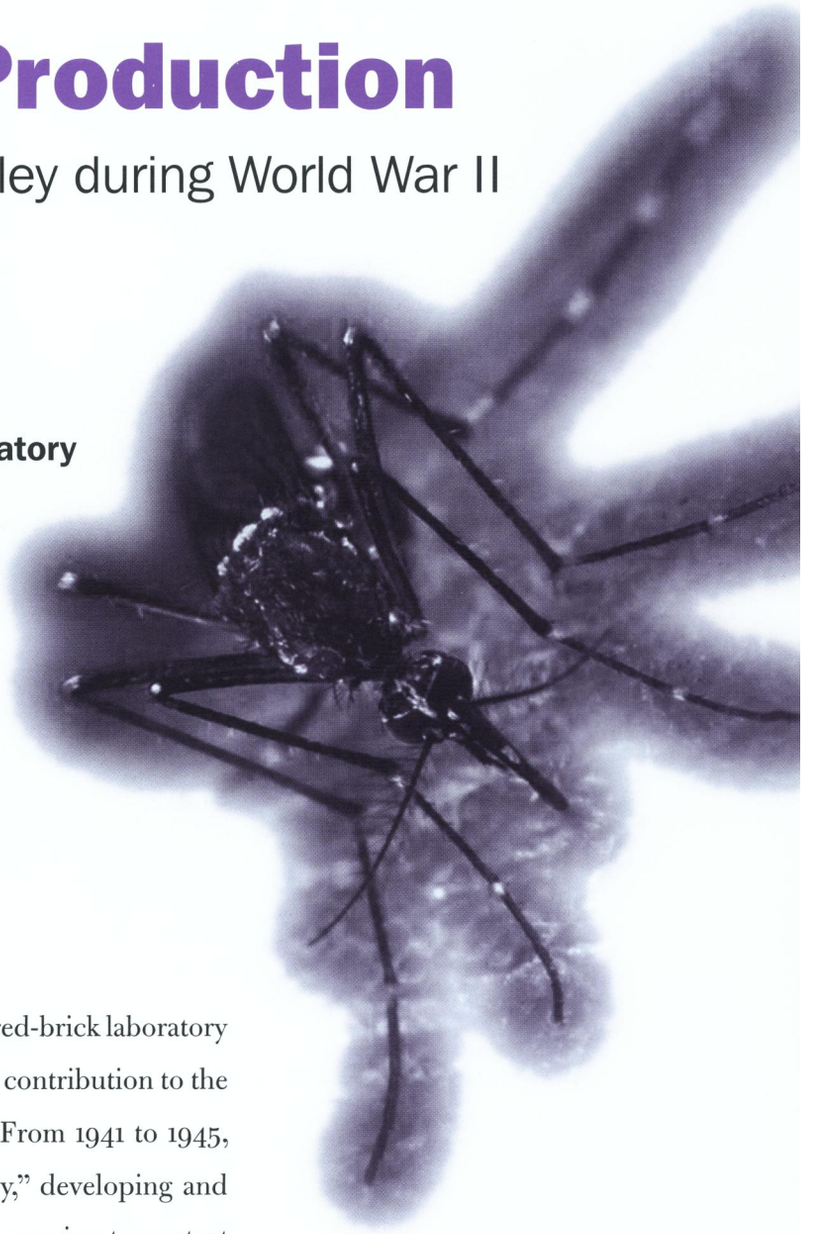
Vaccine Production

in the Bitterroot Valley during World War II

How Rocky Mountain Laboratory Protected American Forces from Yellow Fever

by Gary R. Hettrick



The mosquito *Aedes aegypti*, commonly called the striped house mosquito, transmits yellow fever.
James Gathany and the Public Health Image Library, 28103

Rocky Mountain Laboratory, a small red-brick laboratory in Hamilton, Montana, made a major contribution to the defense effort during World War II. From 1941 to 1945, it became a "national vaccine factory," developing and producing an improved yellow fever vaccine to protect American and Allied soldiers. The new vaccine was the result of collaboration between Mason Hargett, a tropical disease physician, and research technician Harry Burruss that began at a medical research outpost in Brazil in 1938. Their alliance in Montana led to the production of nearly ten million doses of yellow fever vaccine and saved countless lives of Americans fighting in World War II.[1]

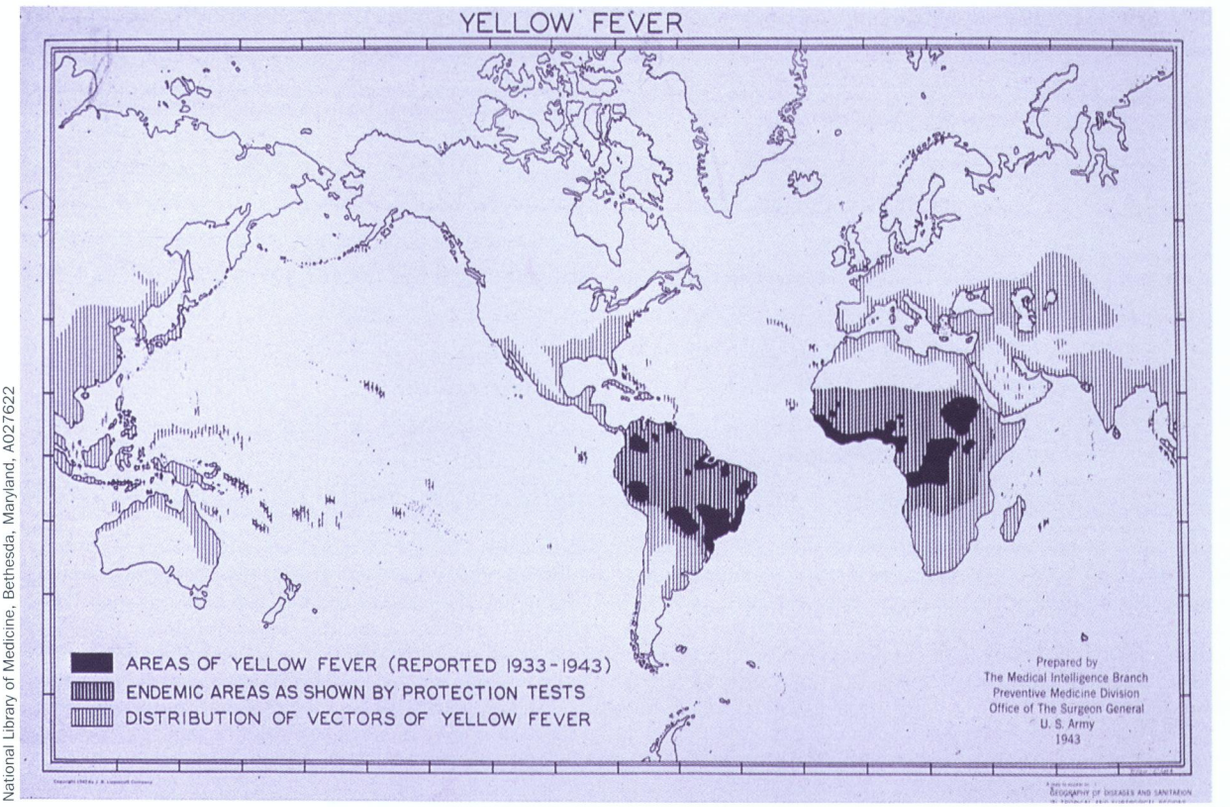
Yellow fever, a hemorrhagic fever, arose in Africa, but it has repeatedly brought devastation and human tragedy to the New World. Transported by slave ships, it came to be known as the "American plague" because, for two hundred years, yellow fever was the most dreaded disease in North America. The virus is transmitted by the bite of a particular mosquito, *Aedes aegypti,* commonly called the striped house mosquito. Symptoms appear three to six days after the bite of an infected insect and begin with chills and a severe headache. Pain grows intense in the back, arms, and legs. Body temperature can rise to 104 degrees. After a few days, the symptoms usually abate, the fever declines, and most patients recover. But sometimes the fever rises again. As the virus attacks the liver and destroys the clotting mechanism, bleeding may occur from the mouth, nose, and eyes. Hemorrhages develop in the intestinal mucosa, and the victim vomits blackened blood. Liver damage causes the skin and the whites of the eyes to turn yellow with jaundice. As the kidneys, liver, and heart continue to deteriorate, the victim falls into a state of delirium, suffers convulsions, and becomes incontinent. This condition is followed by rapid wasting, coma, and death.[2]

During the eighteenth and nineteenth centuries, recurring epidemics of yellow fever ravaged seaport cities and large areas of southern North America. In 1793, Philadelphia had a population of about 50,000. When it became apparent that a yellow fever epidemic was upon the city, panic ensued, and an estimated 17,000 people fled. Of the 33,000 who remained in the city, 1 in 7 perished. After repeated minor outbreaks along the Eastern Seaboard, the pestilence again emerged with a vengeance in Memphis in 1878. Fear led to mass exodus, and within two months the population of 47,000 was reduced to 19,000. Seventeen thousand people developed yellow fever; 5,150 died. The most recent yellow fever epidemic in the United States occurred in 1905 and killed more than 450 people in New Orleans. A U.S. Public Health Service anti-mosquito campaign and the development of sanitary waste-disposal systems have, for the time being, eradicated the scourge from North America. Today, yellow fever strikes as many as 200,000 people each year in tropical areas of Africa and South America, resulting in about 30,000 deaths.[3]

In 1901, when John D. Rockefeller established the Rockefeller Institute for Medical Research in New York City (now Rockefeller University), yellow fever was high on the list of deadly diseases to be studied, and developing a vaccine was a priority. The Institute set up one research laboratory in Brazil and another in Nigeria, countries where the disease was endemic. After three decades of research, scientists created a preliminary vaccine in 1931. The seed virus used to produce this vaccine was grown in mouse brain tissue, but animal testing showed that this vaccine had the potential for inducing encephalitis, or inflammation of the brain. Scientists eventually found that the addition of human immune serum, drawn from people recently recovered from yellow fever—many of them laboratory workers exposed to the virus—would mitigate this serious side effect. Because immune serum was difficult to obtain in substantial quantity, this vaccine was not suitable for large-scale production.[4]

Harper's Weekly (Aug. 16, 1879), p. 652, National Library of Medicine, Bethesda, Maryland, A013097

Yellow fever killed thousands in epidemics in American seaports and large areas of southern North America in the eighteenth and nineteenth centuries. Right, Memphis residents flee the epidemic of 1878, heading for Kansas.

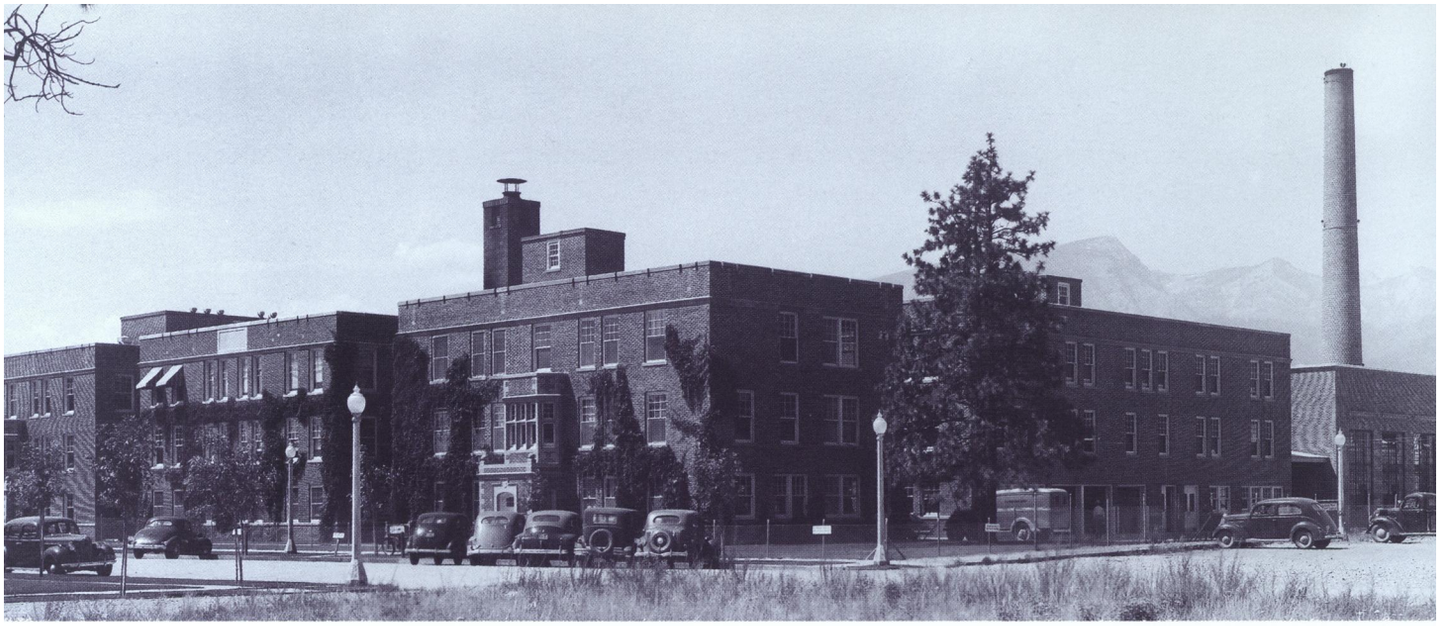


World distribution of yellow fever in 1943

Meanwhile, Dr. Ernest Goodpasture, professor of pathology at the Vanderbilt University School of Medicine, demonstrated that viruses could be readily grown in embryonated chicken eggs. Using Goodpasture's chick-embryo technique, scientists at the Rockefeller Institute successfully produced yellow fever virus in large quantities. Human immune serum, no longer needed to arrest the side effects of the first-generation vaccine, was replaced with normal human serum. The protein in the serum kept the potency of the vaccine from deteriorating.[5]

Another development necessary for large-scale production of yellow fever vaccine occurred in 1936 when Dr. Max Theiler and his colleagues at the Rockefeller Institute developed a strain of yellow fever virus much better suited for producing a vaccine, the so-called 17-D strain. By laboratory manipulation, the strain was weakened to the point where it caused only very mild yellow fever in those vaccinated but stimulated the immune system to produce antibodies that provided immunity against a virulent strain of the virus. The Rockefeller Institute soon set up a vaccine production facility.[6]

The importance of the yellow fever vaccine cannot be overstated for a number of reasons. First, the Public Health Service was concerned that yellow fever could be reintroduced into the United States. The southern states had a large population of the striped house mosquito, and air traffic from South America was increasing in the late 1930s. Since flight times were far shorter than the incubation period, the concern was that infected people who were not yet showing symptoms would arrive, avoid quarantine, and be bitten by the striped mosquito. The mosquito would then carry the virus to humans as it continued to feed; other mosquitoes would bite the newly infected and perpetuate the spread of the virus. This biological chain reaction could lead to an epidemic. Second, by 1939 it seemed likely that the United States would enter World War II, which meant American forces would be sent to areas where yellow fever was endemic. And a third, and more sinister, possibility loomed: that of yellow fever virus being used as a weapon of biological warfare. In 1939, the intelligence community became aware of multiple attempts by Japanese agents to obtain virulent strains



Rocky Mountain Laboratories, National Institutes of Health, Hamilton, Montana

Each spring, many residents of the Bitterroot Valley suffered from a malady known locally as "black measles" because of the severe dark rash that covered the body; the disease was fatal in four out of five adult cases. Starting at the turn of the century, the Montana State Board of Health began to investigate, eventually determining the disease to be Rocky Mountain spotted fever, transmitted by the bite of the wood tick. By 1924, scientists working in makeshift laboratories had developed a crude but effective vaccine. Difficulty in finding adequate facilities to continue vaccine research and tick eradication prompted the Montana State Board of Entomology to ask the legislature for funds to build a laboratory in Hamilton. Legislators appropriated sixty thousand dollars in 1928 to build the Rocky Mountain Laboratory, which by 1930 had a single building and 26 people on its staff. By 1940, when work began on yellow fever, the laboratory (above), now a federal facility, consisted of seven buildings staffed by 107 employees.

of the virus. Strategic American military bases in the Hawaiian Islands and Panama as well as broad areas of the U.S. mainland would be quite vulnerable to the introduction of yellow fever.[7]

Recognizing the inherent vulnerability of a single vaccine production facility, the federal government decided to establish its own under the auspices of the U.S. Public Health Service. In late summer 1940, Dr. R. E. Dyer, director of the National Institute of Health, telephoned Dr. Mason Hargett and instructed him to travel to the Rocky Mountain Laboratory in Hamilton, Montana, to evaluate it as a potential center for preparing a yellow fever vaccine.[8]

Mason Hargett was born in 1904 in northwest Iowa, the son of a Methodist minister. His father instilled in him the value of service to others, and young Mason decided early on to study medicine. In pursuit of that goal, he took an undergraduate degree at Asbury College in Kentucky and then attended Northwestern Medical School in Chicago. He set up a private practice in Oklahoma, but the Depression had hit that state hard and people had little money for doctoring. A colleague of Hargett employed by the U.S. Public Health Service suggested that he join. Hargett passed the exam and over the next couple of years carried out a variety of assignments. "I was the physician aboard a Coast Guard cutter on patrol around Cuba," Hargett recalled. In 1934, the year he was married, Hargett was again assigned sea duty, this time with the International Ice Patrol that monitored the movement of icebergs in the Atlantic shipping lanes: "Married on a Saturday and left on ice patrol on Monday!"[9]

Hargett had developed an interest in tropical medicine, and in 1936 he was sent to the London School of Hygiene and Tropical Medicine. After a grueling course of study, he received a degree in tropical medicine. Because of his particular interest in the yellow fever virus, Hargett was detailed to the Rockefeller research laboratory in Brazil in 1938. There, he met and worked with research technician Harry Burruss. While the main laboratory had moved from Bahia to Rio de Janeiro, Hargett and Burruss spent most of their time "out in the boondocks, searching out patients with yellow fever." Hargett spent the next thirteen months conducting field research and learning how to establish a laboratory capable of producing a vaccine.[10] This experience would be useful when Dr. Dyer called and asked him to go to Hamilton, Montana.

The presence of a research laboratory in Montana was fortunate, if seemingly anomalous. The laboratory owed its existence to earlier efforts to combat Rocky Mountain spotted fever. In the second half of the eighteenth century, settlers began building homesteads in the Bitterroot Valley, and by 1900 the valley supported a population of several thousand. But residents were plagued by a deadly disease that appeared each spring. Locally known as "black measles" because of the severe dark rash that covered the body, it was fatal in four out of five adult cases. Residents appealed to the governor for help. The Montana State Board of Health was established in 1901 and soon after brought scientists to the Bitterroot Valley to investigate the mysterious ailment. They determined the disease to be spotted fever, transmitted by the bite of the wood tick, *Dermacentor andersoni*. By 1924, scientists working in makeshift laboratories—tents, rented cabins, and an abandoned schoolhouse—had developed a crude but effective spotted fever vaccine. Dr. Ralph Parker, who served as Rocky Mountain Laboratory's director for nineteen years, was instrumental in the effort.[11]

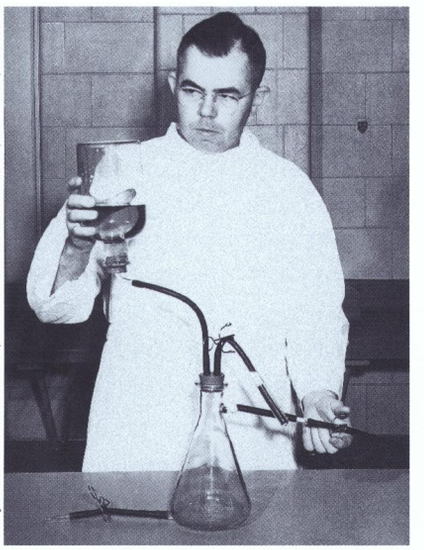
Difficulty in finding adequate facilities to continue this important work prompted the Montana State Board of Entomology to ask the legislature for funds to build a modern entomological laboratory in Hamilton. More work was needed to improve the initial vaccine, and efforts at tick eradication continued. The legislature appropriated sixty thousand dollars, and the first building of the Board of Entomology Laboratory was completed in 1928 on a tract of land at the south edge of town. By 1932, it was apparent that spotted fever was more than a local problem. The infection had been diagnosed in several other states and was now viewed as a national concern, so the federal government purchased the facility and established the Rocky Mountain Laboratory. In 1930, the laboratory had one building and a staff of 26. During the 1930s, the faculty expanded with the addition of experts in parasitology, virology, and bacteriology. Typhus, tularemia, and Q-fever were among the zoonotic diseases (those that can be passed from animals to humans) studied. In 1936, Dr. Herald Cox, recruited from the Rockefeller Institute, used Goodpasture's technique to develop an improved method for preparing spotted fever vaccine. By 1940, the laboratory consisted of seven buildings and a staff of 107.[12]

After visiting Montana, two factors led Dr. Hargett to believe that the Rocky Mountain Laboratory would be ideal for vaccine production. First, the scientific infrastructure was already in place there, and, second, should the yellow fever virus be released accidentally, there would be no danger of its spread since yellow fever–transmitting mosquitoes are not found in Montana. And Hargett knew the right man to help him set up a vaccine-producing laboratory: Harry Burruss. Two years earlier, at the Rockefeller research laboratory in Brazil, Hargett had first met and worked with Burruss. Both men shared a fascination with the yellow fever virus and desired to improve the vaccine used to protect against the "saffron scourge."[13]

National Library of Medicine, Bethesda, Maryland

The National Institute of Health recruited Dr. Mason Hargett, an epidemiologist experienced in tropical diseases, to direct the production of yellow fever vaccine at Rocky Mountain Laboratory in 1940. Hargett had recently returned from Brazil, where he worked at the Rockefeller Institute's yellow fever lab. He stands second from left in this photograph of workers at the laboratory.

Born in Aberdeen, Maryland, in 1904, Harry Burruss completed a three-year premed course at Harvard University in 1927. Unfortunately, he didn't have the funds necessary to go on to medical school. Through a friend, Burruss heard about a research technician position in the Rockefeller laboratory in Lagos, Nigeria, and in the fall of 1928 he left to work



Rocky Mountain Laboratories, National Institutes of Health, Hamilton, Montana

Hargett recruited Harry Burruss, a researcher who had twelve years of experience with yellow fever research, to help set up the lab in Hamilton and hire a staff. Burruss is pictured here transferring vaccine from a storage bottle to a dispensing flask after production had begun.

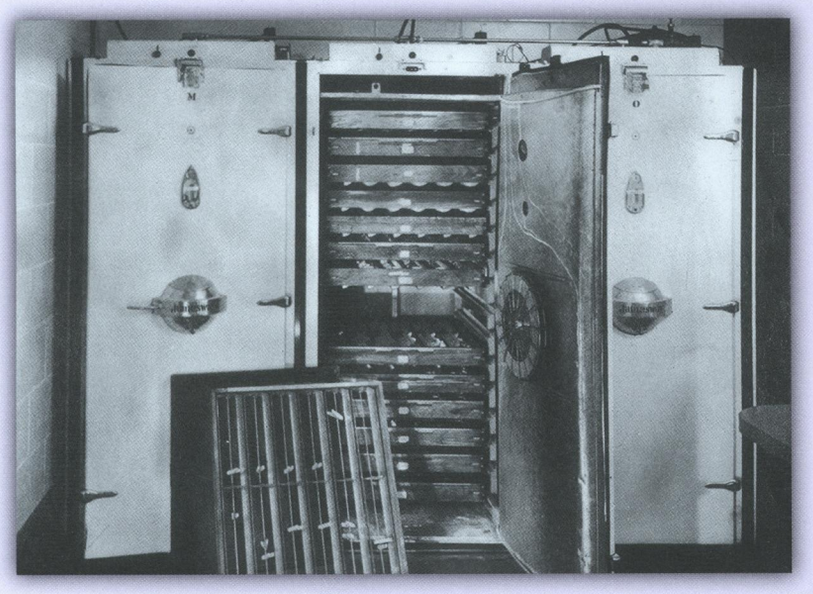
with the West Africa Yellow Fever Commission. Burruss was well aware of the dangers associated with this assignment. The commission began its work in Africa in 1925, and three investigators had already perished from yellow fever. But Burruss gained four years of valuable experience in the laboratory and in the field. He collected blood samples from local populations, both those who appeared healthy and those showing active yellow fever. Back in the laboratory, he tested the blood to identify the specific regions where the infection was endemic. He also sought to determine whether the African yellow fever virus was different from the South American virus and thus whether a single vaccine or two separate ones would be needed. In addition, the commission conducted entomological studies to find out what species of mosquitoes could transmit the disease.[14]

In 1933, the work of the commission was nearing completion, and the Nigerian laboratory would soon be closed. Burruss returned to work at the Rockefeller Institute in New York. After several months there, he agreed to take a position in Bahia, Brazil. His duties there were similar to the work in Africa: "My principal job was testing blood sera to see what percentage of the population in a given area was immune to yellow fever," Burruss recalled. Burruss worked in Brazil for eight years. It was during his time in Brazil that his path crossed Mason Hargett's. Burruss returned to the United States in 1940. He was soon on the way to Montana with his family to assist Hargett in setting up the yellow fever vaccine unit.[15]

In October 1940, Dr. Hargett, along with his wife and three-year-old son, arrived in Hamilton, where they lived for several months while a house was built for them.[16] Shortly after his arrival, Hargett learned the importance of public relations in the Bitterroot Valley. Earlier in the century, confrontations between cattlemen and scientists working to conquer Rocky Mountain spotted fever had shown that the local population harbored a marked distrust of government-imposed programs. One tactic used in tick eradication was to place dipping vats throughout the valley. Ranchers were encouraged (by threat of quarantine) to drive their herds to the nearest station so that the cattle could swim through a trough of arsenic solution. However, preparing an arsenic solution strong enough to kill ticks but not so strong as to burn the hides and udders of cattle was accomplished by trial and error. In June 1913, angry ranchers destroyed a dipping vat near Florence with dynamite and damaged another outside of Hamilton with sledgehammers. Again, in 1927, when it was proposed that a "tick lab" be built in Hamilton, confrontation erupted. Worried that ticks might escape the facility and pose a danger to the community, homeowners in the neighborhood of the proposed site filed a lawsuit to block the project. Ultimately, construction proceeded, but in an effort to alleviate fears a small moat was built around the perimeter of the facility. Ticks, it was supposed, could not swim the moat. Addressing the Hamilton Lions Club in October 1940, Hargett gave club members a thorough description of yellow fever and its history. More importantly, he assured the audience that no danger could come from yellow fever work because the disease was not contagious and the absence of the striped house mosquito meant that the virus could not be transmitted. He also pointed out that new jobs for local people would be created by the project.[17]

On the third floor of the recently constructed south wing of the laboratory, several rooms were assigned to Hargett. "The only equipment I had when I began setting up the laboratory was a chair and a telephone on the floor, so I had the good fortune of being able to build up the operation right from scratch the way I wanted to do it and with the people I selected," Hargett remembered. He and Burruss spent the next few months in hectic work—

Manufacturing yellow fever vaccine was a tedious process, and a stringent sterile environment had to be maintained. Fertile eggs were placed in an incubator with an automatic turning device that rotated them every four hours. After seven days, the eggs were removed, a tiny hole was punched in the top, and the virus injected into the embryo with a small syringe. Technicians sealed the hole with a mixture of beeswax and paraffin and returned the eggs to the incubator for another four days. After eleven days, the eggs were removed and the tops cut off with a small oxyacetylene torch. The embryos were lifted from their shells with sterile forceps, placed in a blender with human serum, and homogenized. Next, the material was centrifuged to remove solid particles. The remaining liquid was the vaccine. It was then portioned into glass ampules—in one-, ten-, twenty-, or one-hundred-dose measurements—and frozen to minus 100 degrees Fahrenheit in a mixture of alcohol and dry ice. Finally, a powerful vacuum machine called a desiccator removed the moisture. The resulting freeze-dried product remained frozen until it was administered. When vaccine was distributed, specific instructions and vials of saline solution for rehydration accompanied each shipment.

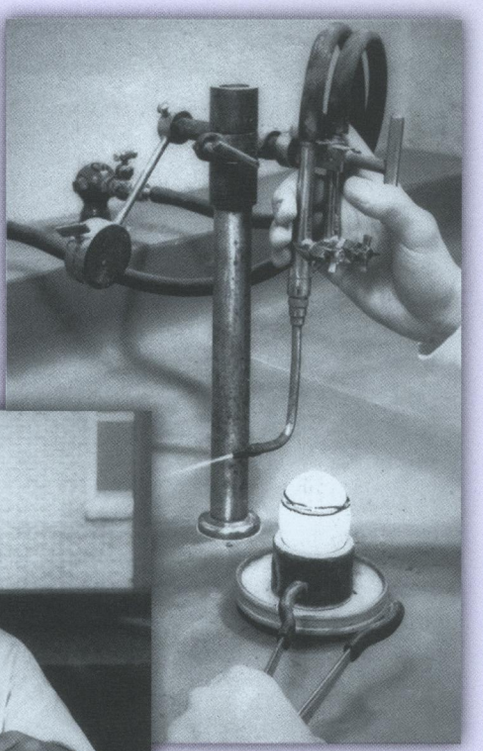


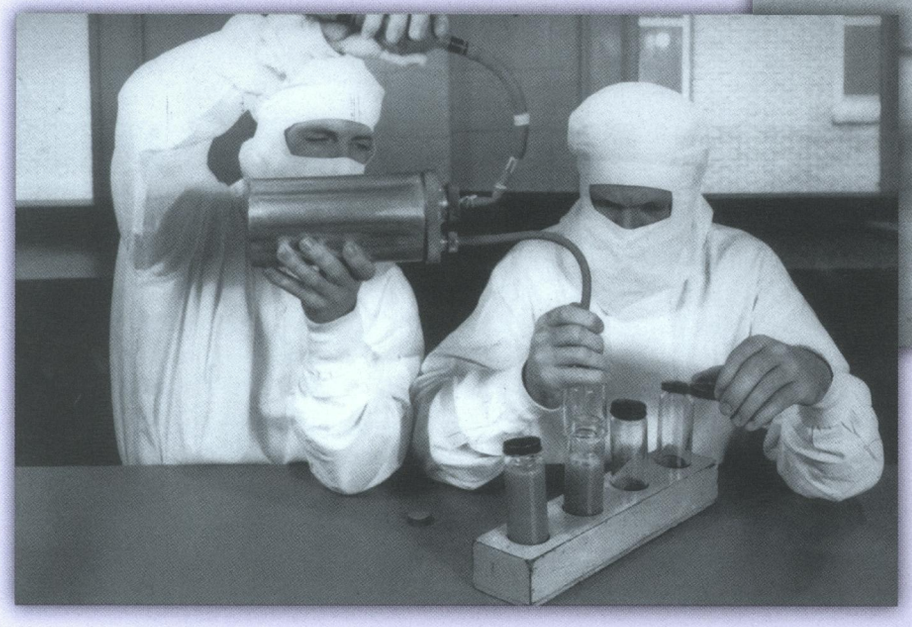
The first step in vaccine production was incubating fertile eggs. By 1942, as production increased, the laboratory installed a three-unit Jamesway egg incubator (right) with a capacity to hold 8,100 eggs.

Below, the lab technician on the left inoculates an egg with yellow fever virus, and the one on the right seals the holes.

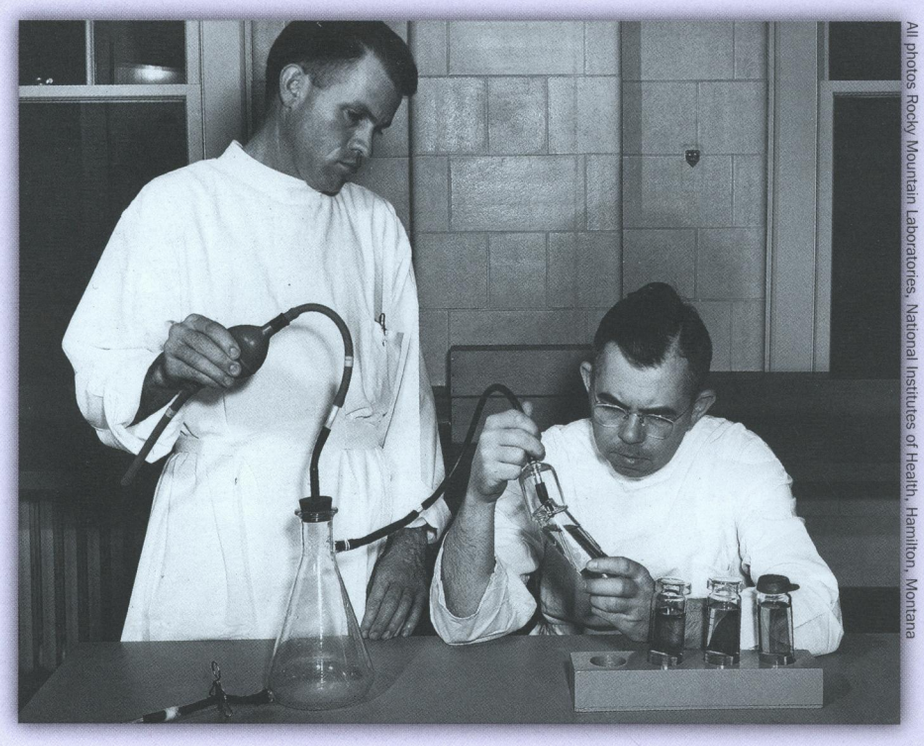
Both photos, Rocky Mountain Laboratories, National Institutes of Health, Hamilton, Montana

Dr. Hargett felt that one of his major contributions to vaccine production was the torch used to cut the tops off eggs. Before it was developed, technicians removed the tops of shells with scissors, a process that left many embryos contaminated. "I suggested they build a tiny oxyacetylene torch in their shop which would cut off the top of the egg and sterilize it at the same time. It worked like a charm," Hargett said in an interview.[18]



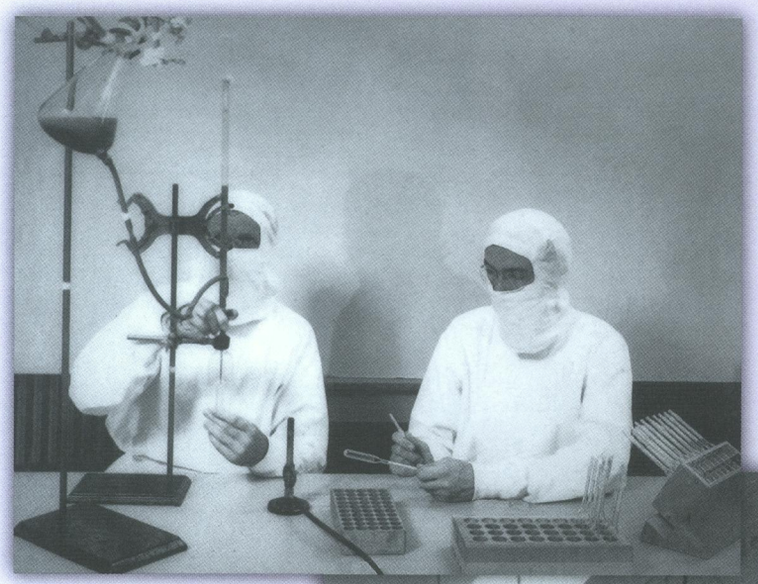


Above, lab technicians pour the liquid chick embryos and human blood serum into centrifuge tubes.

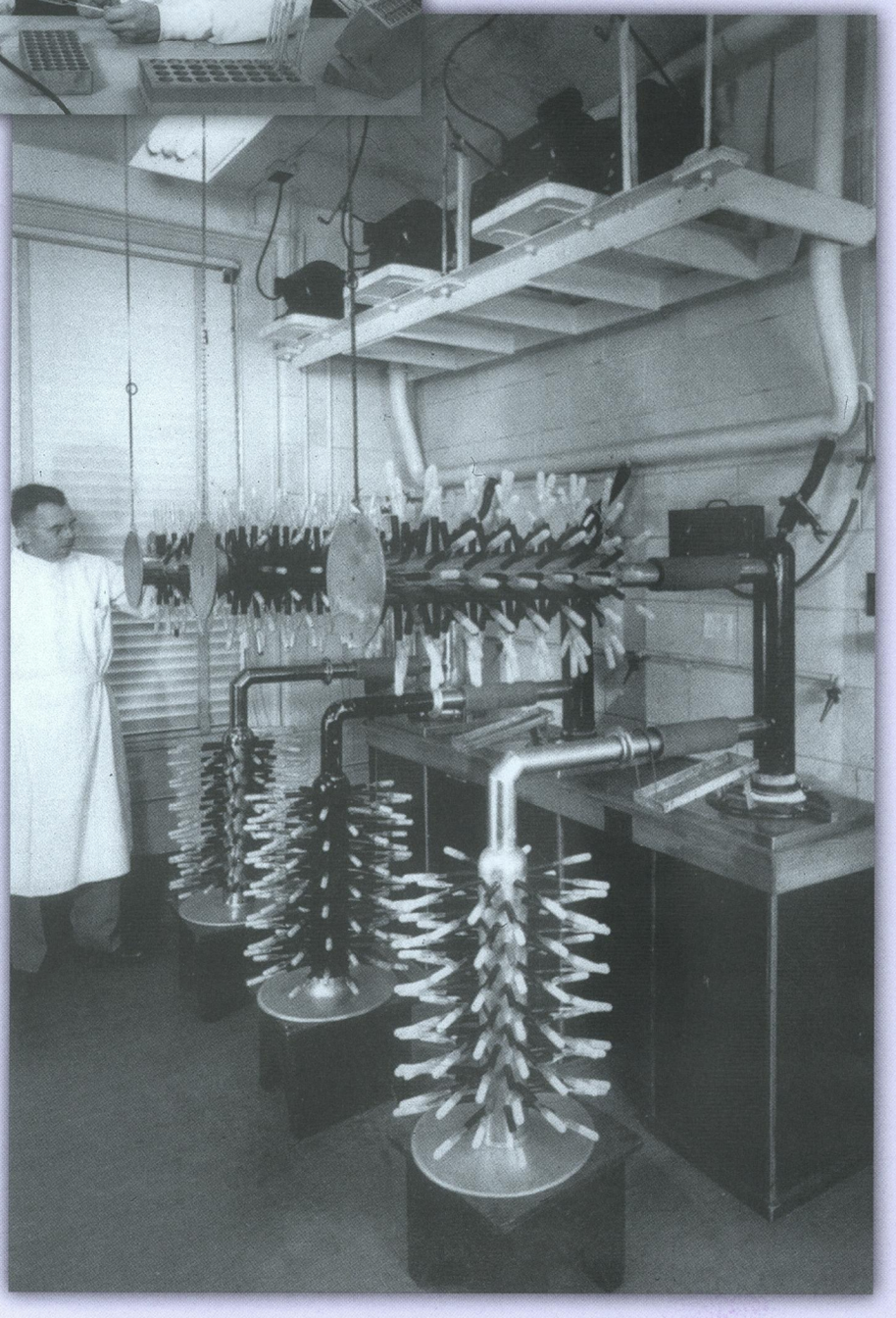


Right, Burruss withdraws vaccine from centrifuge tubes and transfers it to a flask.

All photos Rocky Mountain Laboratories, National Institutes of Health, Hamilton, Montana



The vaccine in the flasks is then portioned (left) into glass ampules.



Moisture is removed from the vaccine by a powerful vacuum machine called a desiccator (right, with Burruss).

procuring supplies, developing equipment, and writing strict protocols for every aspect of the operation. Rocky Mountain Laboratory obtained the 17-D seed virus from the Rockefeller Institute, and a source was established for a steady supply of fertile chicken eggs to grow more seed virus. Students at Montana State University in Missoula (now the University of Montana) donated blood from which serum was obtained; donors received twenty-five dollars per pint. Vaccine production began in February 1941.[19]

At first, the Rocky Mountain Laboratory manufactured a vaccine identical in preparation to that of the Rockefeller Institute at its New York laboratory. But because this formulation included the human serum component, it was vulnerable to the possible introduction of blood contaminants. Aware of this flaw, Hargett and Burruss immediately began exploring alternatives to the serum-base vaccine.[20]

It had been U.S. military policy to vaccinate only soldiers and sailors going overseas, but after the Japanese attack on Pearl Harbor in December 1941 all personnel were immunized against yellow fever. The Rockefeller Institute agreed to supply the military with vaccine, while the Hamilton operation would remain small, producing only what was needed by the Public Health Service for civilian use. Between January 1941 and April 1942, the Rockefeller Institute distributed over 5.5 million doses to the army and navy. Then, in the early spring of 1942 a large number of troops began experiencing jaundice, fever, chills, nausea, and abdominal pains. Unknowingly, the Rockefeller Institute had shipped several lots of vaccine contaminated with what was later identified as the hepatitis B virus. A military investigation would later determine that about 433,000 doses were tainted. Before officials recognized the problem, over 350,000 soldiers had received the contaminated vaccine. For most of those infected, symptoms were not severe and treatment was unnecessary. But more than 50,000 soldiers required hospitalization. Nearly 100 died.[21]

By summer 1941, Hargett and Burruss had perfected an alternative to the serum-base vaccine. Their "aqueous-base" formulation combined distilled water with virus grown in eggs, relying on a high level of protein from chick embryos to serve as the stabilizer. The first testing was done on laboratory personnel and volunteers from Hamilton. One hundred thirty-seven people were vaccinated, and three weeks later their blood was collected and examined. Every sample contained yellow fever–immunizing antibodies.[22]

Rocky Mountain Laboratories, National Institutes of Health, Hamilton, Montana

Because of the risk of blood contaminants in the serum-base vaccine, Hargett and Burruss had developed a new vaccine by summer 1941 that combined distilled water with virus grown in eggs. Above, technicians add distilled water to the embryos before homogenizing.

The director of the National Institute of Health wanted to immediately start field testing Hargett and Burruss's vaccine. He arranged to have several thousand doses sent to a Public Health Service physician stationed in Peru. This trial was under way in spring 1942 when soldiers began getting sick after receiving the Rockefeller vaccine. In April, without waiting for the results of the field tests, Dr. Dyer directed the Hamilton laboratory to start supplying serum-free vaccine to the army.[23]

Plans to expand the Rocky Mountain Laboratory operation took on a sense of urgency. In February 1942, Hamilton's *Western News* reported that President Franklin Roosevelt had requested an appropriation of $77,481 from Congress for renovations and equipment to increase yellow fever vaccine production. Twenty rooms were devoted to producing and testing

the vaccine; the operation employed fifty-one people, mostly local young men and women. After May 1942, all of the yellow fever vaccine supplied to the armed forces was produced in Hamilton. At the same time, other vaccine programs at Rocky Mountain Laboratory were under way. The laboratory manufactured several hundred liters of spotted fever vaccine yearly to satisfy the growing demand for that product, and typhus vaccine, which had become increasingly important to the armed forces, was produced in large quantity. Security at the laboratory increased, too. A fence and street lamps were erected, and armed guards patrolled.[24]

With new equipment in place, Hargett believed the Rocky Mountain Laboratory could produce four hundred thousand doses of yellow fever vaccine a month. A batch took six to eight weeks to prepare, beginning with egg incubation and ending with potency and sterility testing. A three-unit Jamesway egg incubator was installed with a capacity to hold 8,100 eggs. Each day, about 750 fresh eggs were added to the incubator as the same number completed their eleven-day incubation. The lab initially purchased the

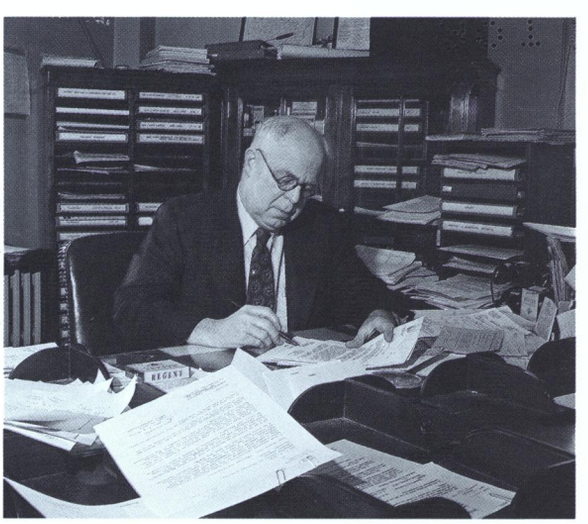
Northern Pacific Railway, *The Northwest* (Nov. 1942), p. 8

Just as the aqueous-base vaccine was being field tested, fifty thousand military personnel inoculated with the serum-base vaccine came down with hepatitis cases requiring hospitalization. Immediately, the new vaccine replaced the older formulation for all yellow fever inoculations. To provide the enormous quantity of fertile eggs required by the laboratory, Sam Downing (right) coordinated with Henry H. Grant (both from families who homesteaded the west side of the Bitterroot Valley in the 1880s) and three other local poultry farmers to assemble a flock of 4,000 laying hens. They supplied 2,600 dozen eggs a month. Below, Henry H. Grant poses with baskets full of eggs from the double-deck chicken house he built in 1942.

Henry Hamilton Grant, *This Is My Bitterroot* (Hamilton, Mont., 1997), p. 20

enormous quantity of fertile eggs needed from farms throughout the Northwest, but local egg producers soon took on the monumental task of supplying the laboratory. Sam Downing and Henry H. Grant, both from families that had homesteaded the west side of the Bitterroot Valley in the 1880s, coordinated with three other local poultry farmers to assemble a flock of four thousand laying hens. They contracted with the laboratory to supply 2,600 dozen eggs a month at ninety cents a dozen. This amount was well above the average price of thirty to forty cents a dozen set by the Office of Price Administration, but the laboratory required that a number of rigorous specifications be met. To minimize the occurrence of egg-borne pathogens, the flocks had to be tested frequently for pullorum disease, a common egg-transmitted *Salmonella* infection, and regularly scrutinized for avian leukemia, "gray-eye," and range paralysis. A minimum of 85 percent of the eggs were required to be fertile, and the hens ate a specified diet of protein, carbohydrates, minerals, and vitamins to ensure this high rate of fertility.[25]

With supplies and equipment in place, production soared. In his monthly report to the surgeon general, Rocky Mountain Laboratory director Dr. Ralph Parker indicated that the Hamilton facility shipped 87,240 doses of vaccine in June 1942: 84,400 to the army, 1,400 to Public Health Service stations, 1,180 to the Coast Guard, 220 to aircraft corporations, and 40 to private physicians. Another 140,000 doses were in the testing stage. By the end of 1942, over 1 million doses had been distributed. When refrigeration units were filled to capacity, the laboratory stored vaccine in low-temperature freezers at the Ravalli County Creamery in downtown Hamilton.[26]



Rocky Mountain Laboratories, National Institutes of Health, Hamilton, Montana

Laboratory director Dr. Ralph Parker (above, 1946) reported that more than one million doses of yellow fever vaccine had been distributed by the end of 1942.

Dr. Parker's monthly reports to Bethesda frequently cited challenges overcome. At one point, Parker noted that vaccine manufacture was stalled by a lack of glass ampules in which to dispense it. Damage to glass ampules during shipment was a continuing problem, and over time the laboratory explored different packing methods. Accidents occurred. One shipment of five hundred thousand doses left the laboratory bound for the St. Louis Army Depot, but as the train traveled through Wyoming, the express car caught fire, destroying the entire shipment. Because a large quantity of frozen vaccine was kept on hand in Hamilton, the shipment was replaced within a few days.[27]

Personnel issues were among Parker's concerns. In 1942, the yellow fever unit needed nine additional employees to meet anticipated demand, a request that lack of funds made "impossible to consider" before the next fiscal year. "The loss of trained employees has put a heavy burden on us as experience has shown it takes a year or longer to thoroughly train a new person," one of Parker's reports stated. In 1943, Harry Burruss and two other key employees were notified that they were subject to the draft, and Dr. Parker pleaded with the surgeon general to take whatever measures necessary to procure deferments "as their loss would be disastrous to vaccine production."[28]

During 1943, Rocky Mountain Laboratory produced 2.4 million doses of yellow fever vaccine, and by the time Japan surrendered in August 1945, its production and distribution stood at nearly 10 million doses. Demand fell precipitously after the end of the war. In 1946, Dr. Hargett was temporarily detailed to the army and served as its chief quarantine officer in Japan, where quarantine camps were established to prevent the spread of disease, particularly cholera and typhus.[29]

With Hargett's departure, Harry Burruss took charge of vaccine production, and under his direction the laboratory continued to produce vaccine to inoculate people traveling to countries where the disease was endemic. Rocky Mountain Laboratory had the only stockpile of yellow fever vaccine in the United States. In January 1949, the Air Force picked

By the end of the war, the Rocky Mountain Laboratory had produced and distributed nearly ten million doses of yellow fever vaccine, protecting the lives of countless Americans fighting in World War II, including these Montana soldiers of the 163rd Regiment celebrating "Montana Day" in the South Pacific in 1945.

MHS Photograph Archives, Helena, PAc 92-8 f1

up 75,000 doses and flew them directly to Panama, where an epidemic had broken out. Another 175,000 doses were en route a few days later. The yellow fever unit stayed in operation in Hamilton until the fall of 1952, when vaccine production transferred to the private sector, the National Drug Company in Swiftwater, Pennsylvania.[30]

In the decades following the war, research at Rocky Mountain Laboratory continued to broaden. A strong program developed to study transmissible spongiform encephalopathies, a group of disorders that includes scrapie, mad cow disease, and chronic wasting disease. Chlamydia trachomatis, the leading cause of blindness in the world, became an important area of research. In 1982, Dr. Willy Burgdorfer brought the laboratory back into the limelight with his discovery of the tick-borne bacterium responsible for Lyme disease, named *Borrelia burgdorferi* in his honor. Zoonotic pathogens have remained an area of study.[31]

Today known as Rocky Mountain Laboratories and part of the National Institutes of Health, the facility is a cutting-edge federal research facility with nearly 450 workers studying a diversity of microbial pathogens from *Staphylococcus* and *Salmonella* bacteria to recently emerged hemorrhagic fever viruses such as Ebola and Marburg.[32]

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Vaccine Production in the Bitterroot Valley

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