Smallpox and the Native American

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ABSTRACT: With the arrival of Europeans in the Western Hemisphere, Native American populations were exposed to new infectious diseases, diseases for which they lacked immunity. These communicable diseases, including smallpox and measles, devastated entire native populations. In this article, we focus on the effect of smallpox on the Native Americans from the 15th through the 19th centuries. Among the "new" infectious diseases brought by the Europeans, smallpox was one of the most feared because of the high mortality rates in infected Native Americans. This fear may have been well-founded, because the Native Americans were victims of what was probably one of the earliest episodes of biological warfare. Fortunately, they were also major beneficiaries of early vaccination programs. Thus, the arrival of smallpox and the decline of the Native American populations are inexorably linked, as the history summarized here illustrates. **[Am J Med Sci 2002; 323(4):216–222.]**

Diseases can shape history. Presently, we are experiencing this phenomenon with the worldwide AIDS epidemic, mad cow disease throughout Europe, and with the Ebola virus in the jungles of Africa. Moreover, we are just now beginning to understand the psychological and medical toll of the intentional introduction of infectious agents such as *Bacillus anthracis* as agents of bioterrorism in the aftermath of the tragedies of September 11, 2001.

When a new disease is introduced into a naive population, the results can be devastating. Entire communities can be eliminated. This was the case when explorers and their slaves brought smallpox to the New World. Although smallpox had been common throughout Europe, Africa, and Asia for centuries,[1] the Americas were unexposed. If smallpox was severe among the whites, it was devastating to the Native American. Smallpox ultimately killed more Native Americans in the early centuries than any other disease or conflict.[2] It was not unusual for half a tribe to be wiped out; on some occasions, the entire tribe was lost.[3] Most disturbing is the suggestion that at times, the exposure of Native Americans to this deadly disease was intentional. Of equal importance, however, is the fact that in the "vaccination" programs spearheaded by Thomas Jefferson, no group benefited more than the Native Americans.

There is no question that the smallpox epidemics that swept through Native American populations from the 17th through the 19th centuries, whether intentional or unintentional in origin, shaped the formation of the country we now call the United States of America.

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Definition of the Disease

An understanding of the role of smallpox in Native American populations necessitates an understanding of the disease itself and how it came to be widespread in the New World.

Known as the variola virus, the origin of the word smallpox is uncertain. The Anglo-Saxon word[1] "smallpox" is believed to have been derived from *pocca,* which means "bag" or "pouch," and the word "variola" from either *varus* or *varius,* 2 Latin words that mean "pimple" and "spotted," respectively. The term variola was used as early as AD 570. But it was the English in the 15th century that first called the disease "small pocke" to distinguish the illness from syphilis, then known as "great pockes."[4,5] It is classified as a member of the Poxviridae family and is closely related to cowpox and monkeypox. However, it seems to be an exclusively human infection.[6]

Smallpox is an acute virus infection that manifests itself in 2 forms: variola major and variola minor. Variola major, the more virulent of the 2 strains, carries an overall case fatality of 20 to 50%,[6,7] whereas the mortality rate of variola minor is less than 1%[8] with only mild symptoms. The last reported case of any smallpox was in Somalia in October 1977. In 1980, the World Health Organization (WHO) Global Commission for the Certification of Smallpox Eradication achieved their goal and officially declared smallpox eradicated.[9]

Typically, respiratory secretions transmit the virus, but it can also be spread from fomites, which occurs when contact is made with infected scab

material residing in bed linens. The virus enters the host via the upper respiratory tract. It then spreads throughout the body by the lymphatic system causing a primary viremia. After it has invaded the reticuloendothelial system, it undergoes extensive replication and a second viremia occurs. The illness manifests itself clinically after an incubation period of 12 days, when the patient begins to complain of headache, fever, malaise, prostration, and pain in the back and muscles. Children often demonstrate vomiting and convulsions.[10] Three to 5 days later, the skin erupts with macules, which over the next 1 to 2 weeks progress to papules, vesicles, and pustules. The rash is typically centrifugal, with greatest concentration on the face, forearms, mouth, palms, and soles.[11] The chest, abdomen, thighs, and upper arms are usually spared. Confluence of the rash typically signals a more severe form[11,12] and ensuing death. During the second week of illness, the lesions start to crust and fall off, leaving the characteristic pockmarks. Secondary bacterial infection of the skin lesions is not uncommon. Complications[13] of the illness include pneumonia, abscesses, septic joints, osteomyelitis, and conjunctivitis leading to corneal ulcers and ultimately, blindness. Smallpox is relatively noncontagious, requiring close contact for spreading to occur. However, it is most contagious after the patient is severely ill and prostrate.

Treatment is simply supportive. The exact cause of death, however, is unclear. The progression to death varies. In the most severe infections, extreme toxemia and extensive hemorrhaging[12] into the skin, lungs, and other organs occur, causing death before the rash even appears.[10] In the case of a more minor infection, complete recovery occurs. Lifelong immunity follows recovery from infection.

The Sixteenth Century: The Introduction of the Epidemic

The 16th century witnessed the widespread use of maritime navigation as a means for travel, transportation of merchandise, and the discovery and conquering of new lands for the European monarchies. These explorers brought diseases with them to the New World, with often devastating consequences for the virgin population. The first reported case of smallpox in the Western Hemisphere occurred in 1507[14] on an island in the West Indies and was presumably introduced by sailors from Spain. Soon thereafter, it became an epidemic resulting in the extermination of entire tribes. Both the Arawaks and Lucayan Indians were decimated.[10,14] With the aboriginal population destroyed by disease, the Spaniards increased the importation of African slaves, thus changing the characteristic of these islands forever. The African slave trade perpetuated the process, as slaves and those involved in the slave trade brought more smallpox. While waiting to be transported, or on board ships, the slaves were herded together. Those persons who became infected were quickly dispatched. Therefore, when the ship and its slaves arrived to the final destination, only those persons, explorers as well as slaves, that were "free of disease" were allowed to come ashore. Unfortunately, this did not account for persons who were in the incubation stage (and there were many), thereby allowing the rapid spread of the disease.

By 1519,[1] the Spaniards, led by Conquistador Hernando Cortes, sailed from Cuba to Mexico. Captain Panfilo de Narvaez from Cuba[2] later aided Cortes in the quest to claim Mexico for the King of Spain. When Narvaez departed for Mexico, Cuba was being ravaged by a smallpox epidemic. The fall of the Aztec empire was hastened by the importation of smallpox from the islands to the mainland and its rapid spread inland. A Spanish friar, arriving in Mexico in 1525, described the recent events as follow: ". . .at the time that Captain Panfil de Narvaez landed in this country, there was in one of his ships a Negro stricken with smallpox, a disease which had never been seen here. At this time New Spain was extremely full of people, and when the smallpox began to attack the Indians it became so great a pestilence among them throughout the land that in most provinces more than half the population died; in others the proportion was little less. For the Indians did not know the remedy for the disease and were very much in the habit of bathing frequently, whether well or ill, and continued to do so even when suffering from smallpox, they died in heaps, like bedbugs. Many others died of starvation, because, as they were all taken sick at once, they could not care for each other, nor was there anyone to give them bread or anything else. In many places it happened that everyone in the house died, and, as it was impossible to bury the great number of dead, they pulled down the houses over them to check the stench that rose from the dead bodies so that their homes became their tombs. This disease was called by the Indians 'the great leprosy' because the victims were so covered with pustules that they looked like lepers. Even today one can see obvious evidences of it in some individuals who escaped death, for they were left covered with pockmarks."[13]

The natives were so frightened of smallpox imported by the Spanish that a missionary wrote, "the Indians die so easily that the bare look and smell of a Spaniard causes them to give up the ghost."[2] With the spread of smallpox among the natives to their advantage, the Spanish were able to conquer the Aztec empire in 2 years, and they continued to push their explorations in new directions. They quickly conquered land to the south, including Guatemala, Honduras, and Nicaragua,[2] bringing with them smallpox to aid in their subjugation. Meanwhile in South America, smallpox rolled ahead of the Spaniards, devastating the Inca empire. Not only did the

Emperor himself succumb to the illness, his designated heir did as well. With no successor, civil war broke out. This internal unrest, in addition to the decimation by smallpox, allowed for an easy conquest by Francisco Pizarro.[1,13]

In the early part of the century, South America had been divided, by papal decree, between Spain and Portugal. The first introduction of smallpox into South America occurred in what is now Brazil, the principle Portuguese colony, in 1555 after the establishment of a French Huguenot colony. The settlers imported with them slaves from Africa and Portugal infected with smallpox.[13] Shortly thereafter, smallpox spread throughout the shoreline and to the interior via the travels of Jesuit missionaries.[12] Over the next thirty years, smallpox epidemics erupted throughout all of South America, completely decimating the native population. Overall, between the years 1550 and 1850, it has been estimated that no less than 3 million Amerindians, from the West Indies as well as Central and South America, died from smallpox alone.[15] The resulting depopulation of the original inhabitants had as much an influence on the history of Central and South America as did the conquistadors.

The Seventeenth Century: The Arrival in North America

At the turn of the 17th century, smallpox was still unheard of among the fewer than 3 million Native Americans living north of Mexico.[13,16] An entire century had passed since the Spanish had invaded Central and South America and had brought with them the deadly smallpox. But the disease had not yet grown to epidemic proportions, even though several European expeditions had traversed this New World. It was not until the French, Dutch, and English established permanent North American settlements that the devastation of Native Americans by smallpox began. Centered on Boston Bay, the first epidemic occurred in 1616 along the Massachusetts coast, eliminating nearly 90% of the Massachusetts tribe of the Algonquin nation.[2] This was later referred to as an act of Divine Providence[2] to clear the land for the settlers that landed at Plymouth in 1620. Four years earlier, the famous Indian maiden Pocahontas died from smallpox after a voyage to England.[14] A second epidemic struck the Native Americans near the Plymouth Colony in 1633.

This outbreak is believed to have arisen out of a dispute between the local Native Americans and the colonists concerning land boundaries.[17] In addition to greatly diminishing the local native population, 20 settlers from the *Mayflower,* including the only physician, were also killed by the epidemic.[16]

The virus began to make its way inland shortly thereafter by way of Dutch traders who traveled along the Connecticut River, which provided an easy route to the St. Lawrence. The beginning of numerous epidemics affecting nearly every tribe in the Great Lakes region is felt to have originated from greed. Several Dutch traders began to live with the Connecticut tribes in hopes of diverting the trade from the English. From this enterprise, 900 of the tribal Native Americans died from smallpox[2,14] by 1634. By 1636, the Huron Native Americans north of Lake Ontario were in the midst of an epidemic that lasted more than 4 years and reduced their population by 50%.[14] Much of our knowledge of this period comes from the records of the Jesuits. Between 1611 and 1764, more than 300 members of the Society of Jesus came from France; these men wrote journals and letters called the "Jesuit Relations,"[14] providing authentic accounts of the smallpox outbreaks. Jesuits were active from the eastern coast of Canada, along the Great Lakes, and along the Mississippi River to New Orleans.[2] The Huron Native Americans believed the French Jesuits "poisoned and bewitched them"[14] and thereby blamed them for the deadly outbreak. The Jesuit Fathers in this region treated the Native Americans by bleeding them and feeding them broth, which was customary European treatment. Despite their caring efforts, the epidemic took a heavy toll on the population. The Native Americans began to blame the "black gowns"[2] for the increasing mortality, thereby escalating the superstitious customs of the medicine men.

As smallpox decimated their tribal numbers, the Huron nation became easy prey to the Iroquois, their traditional enemies. By 1650, the Huron ceased to exist.[14] The Iroquois themselves, however, were not spared. The introduction of the disease seems to have been by means of a war party. The English had joined with the Iroquois intending to assault on the French at Montreal in 1649. Their plans were overturned when smallpox destroyed hundreds of the men, English and Native American alike.

Although we have focused on smallpox in this review, there is no question that during this time other infectious diseases brought by the Europeans, including measles, contributed to the demise of native populations. However, in the eyes of those who had seen tribes wiped out by smallpox, it was indeed a fearsome affliction.[18]

The Intentional Use of Smallpox to Subjugate Native Americans Tribes

In the 17th century the science of medicine was in its infancy. However, even with the limited knowledge of the time, it is reasonable to speculate that the European immigrants to the New World, and ultimately the Native Americans, understood that smallpox was a disease that could spread not only as a result of direct person-to-person contact, but also by clothing once worn by persons with smallpox. Moreover, although based upon published reports that are

now difficult to confirm, the notion that smallpox was deliberately introduced to Native Americans is based on historical notes from this period of time. If these speculations were indeed true, this would make the intentional spread of smallpox by Europeans to the Native American populations one of the earliest instances of biological warfare.

Despite numerous reports of Europeans, colonists and missionaries alike, aiding the Native Americans during their epidemics, the reports of colonists deliberately infecting Native Americans with this deadly disease come from numerous sources. In *The Effect of Smallpox on the Destiny of the American Indian,* Stearns reports, ". . .history records numerous instances of the French, the Spanish, the English, and later on the Americans, using smallpox as an ignoble means to an end. For smallpox was more feared by the Native American than bullets: he could be exterminated and subjugated more easily and quickly by the death-bringing virus than by the weapons of the white man."[2]

One tale reports a white trader wrapping a barrel of rum, of which the Native Americans had grown fond, with a flag infected with the smallpox virus. He presented the barrel as a gift and told them not to unwrap the barrel until they returned to their village. This "Trojan Horse" approach, not surprisingly, resulted in the death of numerous Native Americans.[14]

For all the havoc the disease brought to the Native Americans, the colonists were not spared. Although the Native Americans had no prior immunity, the Europeans were initially immune due to childhood illnesses. However, the towns of North America were too small to maintain the infection endemically, as was the case back in Europe. Repeated introductions through the arrival of new colonists resulted in sporadic epidemics. For example, Boston suffered major epidemics in 1636, 1659, 1666, 1678, 1689, and 1697, with the index case most commonly having arrived by ship. The English began at this point to instill maritime quarantine as a means to protect them against smallpox. By 1662, several areas, including Massachusetts, Virginia, and Long Island, were enforcing local quarantine and isolation to protect themselves from infected immigrants and Native Americans. In 1677, Reverend Thomas Thacher published "*A Brief Rule to Guide the Common-People of New England How to Order Themselves and Theirs in the Small Pocks, or Measles.*"[19] This pamphlet, the first medical pamphlet published in America, was used to serve an explanation of the disease. As the 17th century progressed, travel to Europe frightened the American colonists. It was previously not uncommon for young colonials to travel to Great Britain for their education. But as the European smallpox epidemics continued, fewer gentlemen returned. From this high mortality among American travelers abroad came the development of institutions of higher learning, such as the College of William and Mary.[3]

By the end of the 17th century, smallpox had taken a substantial toll on the European settlers, but this paled in comparison with the toll smallpox took on the Native Americans. Epidemics ranged from Illinois to Arkansas to Mississippi. The native population of eastern North America was nearly decimated by smallpox. It may be that the only thing delaying the destruction of Native Americans of this region was that they were not settled as densely as the Aztecs and the Incas.

The conflicts between the Native Americans and the immigrants from Europe did not end in the 17th century. The 18th century was characterized by massive organized resistance by the Native Americans to the increasing westerly tide of the white settlers. The numerous tribes of the west who had allied themselves with the French retired into the forests at the conclusion of the French and Indian War. When Montreal fell from French to British hands at the end of this war, this came as a frightening shock to the natives who had believed the French were invincible. The Native Americans had fought alongside the French against the English with merciless ferocity. The redcoats were tortured, burned, and sometimes eaten, and the hated English farmers were scalped, slaughtered or held captive.[20] Now, suddenly, the French were evacuating the lands they shared with the Native Americans, leaving them to fend for themselves against the invasions of their enemies. The French had lived in harmony with the Native Americans, being primarily interested in trade and religious conversion. They were never true colonizers. In contrast, the English were farmers that practiced colonization, which was in direct conflict with the beliefs of the Native Americans, who believed the land belonged to no one. Property did not exist in the native culture, only the right to the products of the land. And then the English settler came,[2] built a cabin, and claimed the surrounding half-mile as his own. The Native Americans were subsequently called trespassers for encroaching on their hunting grounds. It was relatively easy for Pontiac, the Great War chief of the Ottawas,[21] to unite the Hurons, the Chippewas, and the Pottawatomies in his crusade against the English. And in short order, other tribes joined in. The war, which became known as "Pontiac's Conspiracy,"[21] lasted until the end of the century. It was the most formidable Native American uprising in American history. The countryside was no longer safe; scalping parties became commonplace, supply trains were captured, and relief efforts were ambushed. In less than 2 months, 8 British forts were taken by surprise and their garrisons were slaughtered.[21] The Native Americans' main objective was to destroy the posts west of the Allegheny Mountains. It was not long before they had taken Fort

Sandusky on the south shore of Lake Erie and Fort St. Joseph on Lake Michigan. In addition, Fort Miami on the Maumee River was taken, as was Fort Quiatenon on the Wabash, to name just a few of their conquests.

In all likelihood, history repeated itself. The uncommon use of intentional introduction of smallpox in the 17th century, as a means to destroying the Native Americans, returned as the English began to grow more desperate to quell the Native American uprising. Sir Jeffrey Amherst, Commander-in-Chief of the British forces, suggested in a postscript to Colonel Henry Bouquet to use smallpox as a means to break up the coalition of the Native American tribes. "You will do well to try and inoculate the Indians by means of blankets, as well as to try every other method than can serve to extirpate this execrable race."[21] Colonel Bouquet replied from Fort Pitt, where smallpox had erupted, "I will try to inoculate the ——- with some blankets that may fall in their hands, and take care not to get the disease myself. . .."[21]

Here the controversy arises. There is no direct evidence that Colonel Bouquet effected this plan. Circumstantial evidence, however, suggests that he did. After Colonel Bouquet left Fort Pitt to launch an expedition across the Ohio River valley, his successor, Captain Ecuyer, was visited by 2 Delaware Chiefs who had come to the fort for the purpose of terrifying the garrison by reports of great numbers of Native Americans marching against the place. Ecuyer noted in his journal, "Out of regard for them, we gave them 2 blankets and a handkerchief out of the smallpox hospital. I hope it has the desired effect."[22] Only a few months later, smallpox outbreaks began to wreak havoc among the tribes of Ohio. Shortly thereafter, Bouquet's expeditions were successful, bringing an end to the great Native American uprising. It was not long afterward that the great Pontiac was assassinated by a member of his own race near what is now St. Louis.[20]

The Beginnings of Variolation in the Eighteenth Century

While Pontiac was fighting for the survival of his homeland, the English settlers were repeatedly battling smallpox in their new homeland. The average death rate from smallpox in Boston between 1720 and 1775 was approximately 37 per 1000 persons. However, this rate doubled or even tripled during epidemics.[16] During this same time, smallpox caused nearly 10% of the total deaths in the United Kingdom.

Lady Mary Wortley Montague, the wife of the British Ambassador of Constantinople,[5,7] is credited with popularizing the act of variolation in the United Kingdom. She learned of this ancient act of prophylaxis from Turkish women. Called "engrafting,"[7] variolation was a procedure performed by elderly women, who made 4 or 5 scratches on the arm with a large needle and introduced into the vein material taken from patients with mild forms of the disease. This resulted in a milder infection with less scarring and, most importantly lasting immunity. Variolation probably originated in China as early as the 10th century by means of intranasal insufflation of powder from smallpox scabs.[23] However, the most common practice was through cutaneous inoculation, which had a shorter incubation period and was usually milder than natural smallpox. In the hands of skilled practitioners, the death rate was less than 1%.

When Lady Montague returned to England, not only did she have her own son and daughter variolated but she also convinced the Princess of Wales to have her 2 children inoculated in the Turkish manner.[5] Variolation subsequently spread rapidly throughout England. Cotton Mather, a minister in Massachusetts who learned of the practice from his African slaves, introduced variolation into the New World in 1721.[5] Interestingly, the African slaves had practiced this ritual for more than 100 years in the colonies, having brought the ancient custom with them from their homeland.[16] Mather was successful in convincing Dr. Zabdiel Boylston of Boston, who himself had smallpox as a child, to try the new method in hope of halting the smallpox epidemic in Boston. Boylston used a "sharp toothpick and quill" to inoculate his only son and 2 slaves[16] with pus from a smallpox patient. Despite fierce opposition from physicians, clergyman, and citizens, Boylston variolated 244 people in all. Only 6 of Boylston's patients died (2.4%). Of the nearly 6000 Bostonians who acquired the infection naturally, 844 died (14%). Most of the remaining 5000 inhabitants of the area either fled into the countryside during the epidemic or were already immune.

During the latter part of the 18th century, variolation continued to have mixed reception in America. It was primarily used during epidemics: Philadelphia in 1730, New York in 1731, and Charleston in 1738. In 1736, Benjamin Franklin lost his 4-year-old son Francis during another epidemic. He is said to "have regretted to the end of his life. . . that he had not had the boy inoculated."[16] Variolation became widespread, with Philadelphia ultimately becoming the leader in the practice because of Franklin's propagandizing in the newspaper he edited, the *Philadelphia Gazette*. In 1776, American soldiers under George Washington were unable to capture Quebec from the English because of a smallpox outbreak that reduced the number of healthy troops by half, whereas the British troops had been inoculated. Ten years later, Washington ordered his entire army inoculated. By this time, however, Canada had been preserved for the British Empire.[5] Despite widespread use of inoculation by the colonists from 1721 to 1798, very few Native Americans were protected.

Less than 20 years after Washington inoculated his army, Edward Jenner discovered vaccination in England. Jenner, an experienced variolator and scientist, noted that cowpox, mild localized disease traditionally acquired from milking infected cattle, protected against smallpox. Over the next 20 years, he collected observational data to test this idea. In 1796, he inoculated 8-year-old James Phipps with pustular material from a lesion on the hand of milkmaid Sarah Nelmes. Six weeks later, Phipps was variolated without effect.[24] Jenner referred to the infectious material as "vaccine," from the Latin *vacca*, meaning "cow". In 1798 Jenner published *Inquiry into the Causes and Effects of Variola Vaccinae* in which he described 10 cases of vaccination and 13 persons who had smallpox in whom variolation was unsuccessful.[25] Dissemination of the news of the discovery spread quickly. The first copy of the "Inquiry" reached America in the early part of 1799, when Benjamin Waterhouse, Harvard's first professor of the theory and practice of physics, received a copy and quickly published the news in a Boston newspaper. Waterhouse performed the first vaccinations in the United States in July 1800, when he vaccinated his 5-year-old son, followed by his 2 additional children and 6 servants, with vaccine he received from England.[26] Before long, the practice spread throughout the northeastern portion of the country.

The Nineteenth Century: Vaccination Begins

The 19th century began with Waterhouse requesting Thomas Jefferson, then President of the United States, to aid in introducing the practice into the Southern states. Jefferson personally vaccinated 70 to 80 members of his own family as well as his friends for a total of more than 200 people.[27] Widespread vaccination reduced smallpox during the early 19th century, although epidemics still occurred in cities. It was also Jefferson who first succeeded in having Native Americans vaccinated.[2] In December 1801, Chief Little Turtle and several of his tribe were vaccinated after Jefferson explained, during a grand embassy of warriors, that "the Great Spirit had made a gift to the white men in showing them how to preserve themselves from the smallpox."[28] Shortly thereafter, Jefferson instructed Lewis and Clark to carry with them some of the vaccine during their explorations and inform the Native Americans of its efficacy.[2]

Outbreaks of smallpox continued despite the growing popularity of vaccination. Despite Jefferson's efforts, the greatest impact of these epidemics in the first half of the 19th century continued to be among the Native Americans. The epidemics of 1801 to 1802 and 1846 to 1840 caused many tribes to become extinct. The epidemic of 1801 ravaged the Native American communities throughout the Plains states and Louisiana from the Gulf of Mexico to the Dakotas. The Omaha, once the most numerous and powerful tribe of the prairies, lost more than two thirds of their tribe, including their renowned chief, Blackbird.[2]

Edward Jenner was greatly moved by the state of the Native Americans. In 1807, he sent a book explaining vaccination to the Chief of the Five Nations. The Native Americans replied by sending Jenner a letter of gratitude in his assistance in driving the fatal enemy of their tribes from the earth.[14]

Although in 1832 Congress appropriated $12,000 for the vaccination of the Native Americans,[2] there was not at this time an organized system to facilitate this act. The vaccines were often unreliable, having lost their potency during the long distances they had to be transported with primitive storage mechanisms. Vaccine was often unavailable. The consequences of these deficiencies were exemplified in the pandemic of 1837 to 1840, which devastated the entire continent west of the Mississippi, from Texas to Alaska. It is estimated that between 100,000 and 300,000 Native Americans[2] died from smallpox alone during those 3 years. This epidemic was responsible for the extinction of what was reported to be the friendliest of the western tribes, the Mandans of North Dakota; it is believed that smallpox was brought to the Mandan by a steamboat delivering supplies from St. Louis to the area along the Missouri River. Reportedly, a Mandan native stole a blanket from the boat from a passenger with smallpox.[2] Smallpox quickly spread from the Mandan to the Assiniboin, Dakota, Crow, Pawnee, Osage, Kiowa, Choctaw, Apache, and Comanche into New Mexico, which then spread back east to various other tribes through traders. The winter of 1839 to 1840 became known as the "Smallpox Winter."[2] Through the course of the epidemic, several treaties between the United States government and various tribes were made to provide vaccine matter, medicines, and physician services to the Native Americans. In 1836, the government agreed to provide the Ottawas and Chippewas with $300 per year to protect their tribes. In 1839, $500 was spent vaccinating the Native Americans of Michigan.[2]

California had been relatively spared of severe smallpox outbreaks until 1828, when a large epidemic began in northern California and spread south to San Diego, killing large numbers of Mexicans and Native Americans. Throughout the remaining years of the century, California reported some of the worse epidemics, which were precipitated by the migration of white men into the area, mostly in search of gold. The Pueblo and Hopi epidemic in 1898 to 1900 in New Mexico and Arizona was the last major smallpox epidemic in Native American history.[29]

By 1880, the Indian Service had been created and employed 77 physicians in 4 hospitals. However, it was

not until the first decade of the 20th century that delivery of health care was regarded as one of the major services of the agency. Before this time, traders and priests provided most of the distribution of vaccine and medications. In 1882, the US government spent $1,430.35 for vaccine, which was hardly enough to provide services for the 300,000 Native Americans. In May 1900, through the Indian Legislation of the United States, an act was passed appropriating $50,000 or more, as necessary, to suppress smallpox in the Indian Territory. The Census Bureau estimated that the Native American population at the time was 237,196 that year. After 1905, smallpox was of little social significance among the Native American population. Vaccination of the native children attending school became compulsory in 1907. In 1938, a total of 5,078 Native American deaths were recorded. Only one of these was from smallpox.

Conclusions

The introduction of smallpox into the Western Hemisphere has had devastating effects. Through the centuries, entire aboriginal populations have become extinct because of this disease. It shaped the areas that we now call North, South, and Central America. Although the majority of the epidemics that affected the Native Americans were accidental, it seems that some were initiated by intentional infection of a group of Native Americans by European settlers. This most probably represents the first biological warfare used in the United States. Although the ancient custom of variolation helped contain the disease, it was Jenner's work that allowed the first scientific attempt to control an infectious disease. Both Waterhouse and Jefferson understood the potential implication of this medical discovery, both for their time and for the future. Their insight helped bring this devastating disease under control. This not only shaped the future of the Native American but also had global implications, as demonstrated by the official eradication of this disease worldwide.

Today we face enormous concerns of terrorist use of biological agents. To date, reports of bioterrorism have focused on the use of *B anthracis.* Anthrax, although deadly in its inhaled form, does not spread from person to person as smallpox does. It is likely that few of us today are immune to smallpox, because the duration of immunity conveyed by smallpox vaccination is probably less than 10 years; we face the same feared consequences of this disease that the Native Americans did 2 centuries ago.

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