

7-1-1996

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Kraemer, Paul. "Sickliest Post in the Territory of New Mexico: Fort Thorn and Malaria, 1853–1860." *New Mexico Historical Review* 71, 3 (1996). <https://digitalrepository.unm.edu/nmhr/vol71/iss3/2>

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Sickliest Post in the Territory of New Mexico: Fort Thorn and Malaria, 1853–1860

PAUL KRAEMER

In 1853, Fort Thorn was established on the west bank of the Rio Grande at Santa Barbara, a new settlement near the present-day community of Hatch, New Mexico.¹ This was the year of the Gadsden purchase and the general military policy in New Mexico was one of consolidation. The primary objectives were to protect the principle centers of population and to station troops in positions along Apache raiding routes.²

Selection of the Santa Barbara site for Fort Thorn was dictated by the need to guard a sparsely settled segment of the Santa Fe–El Paso road, as well as the San Diego Crossing, for the wagon road to California laid out in 1846 by Cooke.³ As a consequence of repeated epidemics of malaria (or “ague” as it was then commonly known), the fort was proclaimed to be the “sickliest post in the Territory” and abandoned after only six years of service.⁴

Although not known at the time, malaria is known to be caused by various species of the protozoa *Plasmodium*. Of the two most common types, *Plasmodium vivax* produces chills and fever with a characteristic periodicity of the symptoms due to the life cycle of the parasites in the blood. New cases can often be recognized by the violent intermittent attacks every forty–eight hours. The disease is extremely debilitating but usually subsides in ten to thirty days without many deaths. *Vivax malaria*, the type involved in the events at Fort Thorn, should be distinguished from malaria caused by *Plasmodium falciparum*, which even to the present day causes numerous deaths in several parts of the world.⁵

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According to the surviving reports of the army surgeon general's office, the decision to abandon Fort Thorn was made with the belief that the site was intrinsically unhealthy, a nebulous notion that reflects mid-nineteenth century ideas about malaria. These same reports contain the essential statistical data, however, that make it possible to re-examine the Fort Thorn problem in terms of modern concepts of etiology and epidemiology. Since medical personnel and health records were almost non-existent in New Mexico prior to the American military occupation, these records present a rare opportunity in historical epidemiology.⁶ With few exceptions, New Mexico's historical record on epidemiology lacks accessibility.⁷ The picture that emerges suggests that what happened at Fort Thorn reflected the very beginning of a general New Mexico problem that was to continue for almost a hundred years.

During most of the antebellum years, approximately 10 percent of the total United States Army strength was stationed in New Mexico.⁸ In 1853, when Fort Thorn was established, about 1,200 troops from a standing army of 10,000 men were stationed in New Mexico.⁹ The troops were dispersed among widely separated posts in a fluid fashion. During the six-year period covered by the surgeon general's report of 1856, quarterly reports of the sick were received from twenty-four posts—although no more than ten positions were usually garrisoned at any given time.¹⁰ In general, each post had its own surgeon. In September 1850, ten out of eleven garrisons were provided with a medical officer.¹¹ Army regulations required a degree of uniformity in the manner, frequency, and quality of medical reports, a stringent regulation for that time.¹²

Problems at Fort Thorn appeared in two special reports, published with the surgeon general's report of 1860. In the first, written in September 1856, assistant surgeon T. Charlton Henry said:

The garrison of Fort Webster was first located in this spot, in November, 1853. Upon reference to my quarterly reports for the year 1854, you will observe my sick list exceedingly small; indeed, there was scarcely any sickness at the post the first year of its settlement.

But now *quantum mutatus*. About the 10th of September, last year, ague appeared and a large proportion of the command here were victims of its influence. That fall also was somewhat prevalent, though but to a small extent, bilious remittent fever. But, sir, this year how vastly exaggerated is the sick list; and reasoning *à priori*, what may it not be the ensuing year, subsequent to the advent of warm weather. For about the 5th of July of the present year bilious remittent fever made its accession, and continued to prevail till about September 8, when ague seemed in a

great measure to succeed it. The month of July last, seventy-eight men out of ninety (the entire command) were sick with remittent fever. In the latter portion of August, Major Blake, of the First Dragoons, encamped near here with one company of recruits and the regimental band, and was in a fortnight subsequent joined by two more companies. Sickness, especially ague, commenced very soon after among his men. . . .¹³

Dr. T. Charlton Henry did not lose any of these patients; nevertheless, he pleaded:

In conclusion, sir, let me urge on the powers that be that the position of this post be removed, and let me suggest that it be not far from the old station of Fort Webster. In a military point of view it would be fully as effective. Does any one for a moment believe, and would any one of good sense urge, that it would promote "the good of the service" to retain troops *precisely* in this position, when a removal of only ten or twenty miles westward (the site of old Fort Webster is fifty) would tend to keep the command in nearly perfect health all the year, instead of remaining here, two thirds of the command being perfectly unable to do service nearly one half of every year.

Were there no surgeon at this, the sickliest post in the Territory at this time, and the prevailing malady not properly treated, every man here, very nearly, would, after a series of attacks of ague or fever be seized—as the Mexicans about us and below us are—with a congestive type of fever, and die off like so many sheep with the rot.¹⁴

Two years later, in September 1858, a new post surgeon, Dr. P.A. Quinan, wrote his estimate of the problem and its cause:

Fort Thorn is located upon the immediate edge of an extensive marsh, the river making a considerable bend at this point, leaves exposed to the right, a crescentic flat, intersected by numerous sluices, and at times completely inundated. The buildings constituting the fort are placed within a stone's throw of the swampiest portion of this flat or bottom, and in the most admirable manner, if the object be that the garrison shall inhale, for an average period of five months, the pestilential effluvia arising therefrom. The bottom referred to, presents during the hottest months, a surface of oozy mud, covered with green slime, and interspersed with pools of stagnating water, which surface is during these months gradually drying up. During the same time,

a rank vegetation of weeds and grasses undergoes the process of germination, advancement to maturity, and decay. As might be expected, fevers of a malarious character, have greatly afflicted the command during this quarter. These diseases have prevailed to even a greater extent than in former seasons, which may possibly be due to an unusually continued elevation of temperature, and the absence of rain, which serves to prevent the fall of the river and stagnation of water in the neighboring sluices. Fevers began to manifest themselves about the middle of July, and have continued with much virulence until the present time. The command then consisted of two companies, and the sick report numbered seventy cases. The garrison was reduced on the 1st September, to one company of infantry, half of which has since been removed to Fort Fillmore on detached service. Scarcely a man of this command can be considered fit for the performance of ordinary garrison duty, so debilitated are they by disease.¹⁵

Both Henry and Quinan believed that the fevers were caused by the inhalation of "miasmas" or "effluvia" that arose from marshes or stagnant water. Their beliefs were entirely consistent with contemporary medical doctors, including Dr. Benjamin Rush.¹⁶ In 1850, Dr. Daniel Drake undertook a massive effort to determine the secret of malaria transmission. But as noted in a 1968 study, "We who can see the answer so plainly, long to reach out and help him, he [Drake] came so close."¹⁷ Both Drake and Rush believed that undrained marshy areas were the main source of malarial fevers, and that transmission occurred by inhalation of toxic gases. One question that Henry and Quinan apparently did not consider was why the Fort Thorn site should suddenly be so noxious when the area had seen a constant flow of travelers since the time of the Chamuscado-Rodriguez expedition of 1581, and since nearby Robledo and San Diego had been used as layover camps for many years.¹⁸ In fact, as Henry himself reported, the site was perfectly harmless for the first two years after the fort was established—from November 1853 until September 1855. It must be recalled, however, that not only were basic facts about malaria completely unrecognized, but the basic nature of communicable diseases and the demonstration of arthropod vectors (or insect carriers) of disease remained to be discovered. Indeed, the status of knowledge of malaria was actually more advanced than most other infectious diseases since specific therapy, such as quinine, was known and drainage or avoidance of marshy areas was known to have a beneficial effect.¹⁹

The surgeon general's reports of 1856 and 1860 include descriptive sanitary reports only for those posts where the post surgeon elected to write them. The bulk of the data consists of mortality and morbidity data consolidated for each region rather than for each post separately. Although it is clear from the data that Fort Thorn was not the only post affected, the actual fort-by-fort distribution of cases may never have been compiled.²⁰ The medical director of the Department of New Mexico, surgeon William J. Sloan, however, gave an overview of the situation in a special report dated 17 July 1859:

In the latitude of Santa Fe, these fevers are unknown; as we proceed south and strike the Rio Grande, at Albuquerque, after a distance of sixty-seven miles, and a descent of 2,000 feet, we meet all the coincidences necessary for their development except a high range of temperature; proceeding down the valley of the river, there is very little fever development until Fort Craig is reached. There, the river bottom presents all the indications necessary; but its well-selected site, on an elevated mesa, and its airy, ventilated quarters prove a barrier to the inroads of the poison. From this point south to Fort Thorn, we find the fevers of a higher grade and fully developed. . . . This state of things exists as we advance further south; and Dona Ana, and Cruces, with Fort Fillmore, and the Mesilla Valley, form the great centers of intermittent and remittent fever in the fall. . . .²¹

According to the reporting practices of the time, malaria was not reported as a single entity, but rather as various intermittent and remittent fevers. Thus, mid-nineteenth century errors in diagnosis and false concepts of disease entities could have introduced problems into any attempt to re-analyze the numerical data.²² It seems unlikely that cases of yellow fever, typhus, typhoid, and dengue, however, were confused with the malarial fevers reported in New Mexico. For one thing, the post surgeons, including both Henry and Quinan at Fort Thorn, consistently reported that their patients responded to quinine, which would not be the case with other types of fever.²³ In addition, the low mortality rate associated with their cases separate them sharply from several similar illnesses.²⁴ Indeed, as a consequence of the large impact of malaria on troops during the Seminole War in Florida (1836-42), the army had invested a great deal of effort in the details of malaria diagnosis and treatment, and in reporting the clinical manifestations of disease uniformly.²⁵ Therefore, it appears likely that the statistical data retain objective value, despite the fact that the basis of malarial transmission was not understood at the time.

Data recorded between 1849 and 1859, presented in table 1, consist of quarterly summaries of the number of cases of malaria reported, in addition to the number of troops at risk during the same quarter. Hence, the data may be used to estimate an incidence rate by dividing each of the quarterly case numbers by the respective troop strength for that quarter. The average yearly "relative incidence" values (x100) are presented graphically in figure 1 with the "mean strength" numbers for the Department of New Mexico, and analogous incidence values for the army as a whole.²⁶

When presented in this fashion, several significant observations can be made. It is apparent that the initial troop buildup in New Mexico, which took place in the first three years following the war with Mexico, was not associated with an increased incidence of malaria. This initial buildup included staffing of posts such as Fort Fillmore and Fort Conrad in portions of the territory that would later become the worst malarial region.²⁷ Hence, the numerical data for the territory as a whole confirm the descriptive data of Dr. Henry at Fort Thorn, to the effect that malaria was not a serious problem until much later.

In addition, New Mexico's malaria experience is distinctly different from that of the army as a whole. During the four-year period 1849-52, when overall army incidence values were sharply ascendant, the situation in New Mexico was actually improving. This declining incidence coinciding with the troop buildup in New Mexico strongly suggests that the few cases that were reported represented malaria contracted before arrival in New Mexico. The frequency of these earlier cases, as evident in table 1, did not show the strong seasonal influence shown after 1854.²⁸ In the earliest territorial years, many malarious troops had successful remissions because they were not reinfected in New Mexico. By 1853, most troops had been exposed to malaria prior to their service in New Mexico. Thus, indigenous malaria was not maintained in New Mexico prior to the entry of numerous infected United States soldiers. The subsequent problem at places like Fort Thorn was related to the presence of potential vector mosquitoes (*Anopheles freeborni*) which became infected from these active cases.²⁹ Consequently, New Mexico did not give malaria to the army; the army gave malaria to New Mexico.

Such a conclusion might appear to fly in the face of the obvious possibilities for introduction of malaria from Mexico. Indeed, a steady stream of travelers from Mexico had been passing through the mosquito-ridden territory of the Río Abajo for over 250 years. Furthermore, the high prevalence of malaria in much of Mexico was recognized from the time of the earliest conquistadors. Bernal Díaz mentions that Cortés was suffering from malaria during his first march on Mexico City from Vera Cruz. In the late eighteenth century, accounts of Father Ignaz Pfefferkorn in Sonora, the businessman Pedro Alonso O'Crouley, and

TABLE 1: MALARIA IN TROOPS IN NEW MEXICO

	1st quarter	2nd quarter	3rd quarter	4th quarter	TOTAL
1849: Cases	6	2	30	43	81
Mean strength	259	243	684	619	451
1850: Cases	36	40	42	59	177
Mean strength	815	727	873	1,106	880
1851: Cases	17	28	16	14	75
Mean strength	1,070	1,042	1,244	1,034	1,098
1852: Cases	13	11	16	25	65
Mean strength	1,059	1,060	1,168	1,062	1,087
1853: Cases	16	30	51	36	133
Mean strength	1,249	1,164	1,094	1,218	1,181
1854: Cases	52	50	22	82	206
Mean strength	1,435	1,049	1,063	1,156	1,176
1855: Cases	23	12	65	170	270
Mean strength	1,038	903	1,134	1,338	1,103
1856: Cases	36	90	282	240	648
Mean strength	1,490	1,477	1,379	1,810	1,539
1857: Cases	111	120	448	332	1,011
Mean strength	1,736	1,314	1,382	1,654	1,522
1858: Cases	125	146	630	563	1,464
Mean strength	1,833	1,519	1,413	1,915	1,670
1859: Cases	272	261	382	356	1,271
Mean strength	1,799	1,737	1,625	1,781	1,736

*SGR, 1856, pp. 432–35; SGR, 1860, pp. 230–33. Cases represent the pooled values for *Febris intermittens* (quotidiana, tertiana, and quartana) plus *Febris remittens*.*

the Virginian John Peyton, testify to the prevalence of malaria in large portions of Mexico. Peyton found malaria below the 30th parallel only. Around the time of the American takeover in 1846, John Russell Bartlett and others emphasized the healthfulness of the New Mexico climate. Considering the high prevalence of malaria in temperate regions at that time, these statements imply that New Mexico was free of indigenous malaria.³⁰

The history of malaria in northern Sonora and southern Arizona is quite distinct from New Mexico. From Pfefferkorn's and Bartlett's descriptions, and the problems at Fort Buchanan, endemic malaria appeared in Arizona and Sonora earlier.³¹ The Arizona–New Mexico distinction reflects some of the cases reported between 1856 and 1859 (as shown in table 1 and figure 1) undoubtedly derived from quarterly reports emanating from Fort Buchanan, located near the border south of Tucson. The first federal troops that took possession of southern Arizona, camped near Calabasas in 1856 and built Fort Buchanan in March 1857. The area remained part of the Department of New Mexico until June 1865.³² According to a special report written by assistant surgeon B.I.D. Irwin in February 1859, Fort Buchanan reported 172 cases of fevers in 1857 and 453 cases in similar reports in 1858.³³ Located in an endemically malarious region in Arizona, reports of malaria from Fort Buchanan inflated reports for the entire Department of New Mexico as a whole by 17 percent in 1857 and by 30 percent in 1858.

The constant exposure of New Mexicans to persons from malarious Mexico for almost 300 years failed to establish the disease in New Mexico. Yet the influx of United States troops in the 1850s produced a serious and long lasting problem. Any clear understanding of this paradox was completely beyond the knowledge of the mid-nineteenth century physician. Some fifty years later, however, following the work of Louis Pasteur, Robert Koch, and others concerning the general nature of infectious diseases, basic knowledge about malaria provided an explanation for this paradox. In particular, the work of Sir Ronald Ross between 1898 and 1917 is especially applicable to the New Mexico situation.³⁴

Ross discovered that transmission of malaria from man to man required the intermediary services of mosquitoes, not merely to inoculate the human victim, but also to allow the completion of the life cycle of the parasite that causes the disease. This was a monumental discovery. In addition, these facts make the year-to-year maintenance of malaria in temperate climates more complicated. Since only a very few mosquitoes survive winter in New Mexico, a new supply of infected people must carry malaria every year for the disease to continue. In other words, malaria must winter in people, not in mosquitoes.³⁵

Ross went much further than this, however. In 1908, he made the first attempt to describe malarial transmission in quantitative terms.³⁶ His classic equation is as follows:

No. of new infections per month = $(p)(m)(i)(a)(b)(s)(f)$, where
p = average population in the locality;
m = average proportion of the population infected;
i = proportion of infected population who are infectious to mosquitoes;
a = average number of mosquitoes per person;
b = proportion of uninfected mosquitoes which feed on man;
s = proportion of mosquitoes which survive the extrinsic incubation period; and
f = proportion of infectious mosquitoes which feed on man.

Since the incidence of new cases is a product of seven factors, for malaria to be "successful" it is necessary for every one of the seven quantities to be significantly above zero. In particular, if two or more are very low, malaria will not "succeed" no matter how high other factors are. It was Ross' genius to show that quantitative considerations are necessary in understanding qualitative descriptions.

Today, we know that even Ross' seven variables are not the whole story.³⁷ Nonetheless, Ross' work seems sufficient to explain most of the paradoxical features of the situation described above. In particular, the consequences of Ross' first variable—population—were probably critical in preventing the establishment of malaria prior to the 1850s. There were simply too few people in those areas of greatest vector concentration to support malaria. New Mexico in general, and especially the lower Río Abajo, was extremely underpopulated compared to malarious areas in Mexico and the United States. For many years before 1846, few people lived between El Paso and Socorro. In addition to its intrinsic effect, the sparsity of population also affected other variables in Ross' equation, such as the proportion of infected and uninfected mosquitoes that feed on man—variables *b* and *f*.³⁸

Take, for example, a small number of active malarial travelers coming up from Mexico. In passing through a vector area, they infect at most a few hundred of the millions of mosquitoes in the area. After the extrinsic incubation period, unless susceptible travelers come along, the proportion of infected mosquitoes that feed on man will be zero. Even if susceptible travelers arrive in a timely fashion, the few infected mosquitoes will be competing with the uninfected ones for the travelers. In other words, the maintenance of malaria requires an adequate number of people who must be fed upon by a significant proportion of the total mosquito population. If not, malarial transmission will not merely be less frequent; it will be nonexistent.

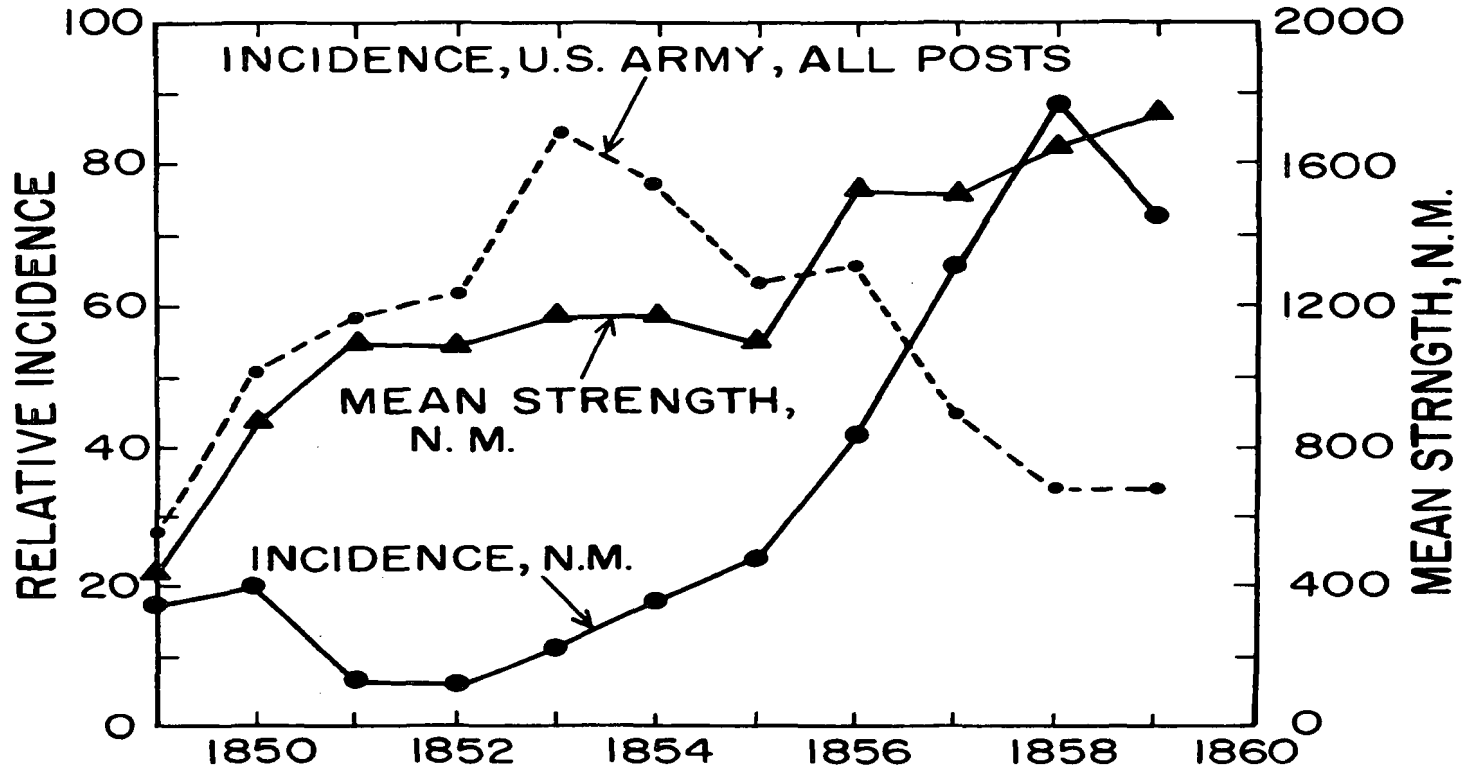


Figure 1: Malaria in troops in New Mexico and in the army as a whole, 1849-1859; *SGR, 1856*, pp. 432-35, 489, *SGR, 1860*, pp. 230-33, 322.

The present study focuses on Fort Thorn in part because of the existence of the special sanitary reports, including Dr. Henry's assertion in September 1856 that Fort Thorn was the "sickliest post in the Territory." In addition, despite the numerous changes in the locations of posts during this period, Fort Thorn was the only one abandoned specifically because of malaria.³⁹ These facts do not, however, prove that New Mexico's acquisition of indigenous malaria occurred uniquely at Fort Thorn. The change could have been multifocal involving other posts in the area, such as Fort Fillmore. Fort Conrad, with its proximity to the river, possibly just missed serious problems by its abandonment in 1854. Doña Ana had already been abandoned.⁴⁰ In 1852 and 1853, these and other posts, including Socorro and Fort Conrad, rarely reported malarious fevers.⁴¹ Thus, what happened at Fort Thorn was an especially important conjunction of epidemiological and historical factors that caused New Mexico to acquire indigenous malaria.

During the years before the Civil War, the army considered malaria problems in the Department of New Mexico important because of previous experience in Florida and elsewhere. Between 1855 and 1859, malarial fevers were the leading cause of illness in the army as a whole.⁴² In the consolidated reports for the Department of New Mexico for the same period, malaria ranked with wounds and injuries as a leading cause of illness.⁴³ Some of the sanitary reports provide insight on the health status of New Mexico's civilian population during this period. In the sanitary reports that preceded these outbreaks, post surgeons at Fort Conrad, Fort Defiance, and Socorro all reported that both Native American (Navajos and Apaches) and Mexican populations were generally healthy. Venereal diseases were frequently noted. Surgeon J.F. Hammond described high mortality among children with whooping cough at Socorro in 1852. In fact, the latter report concludes that malarial fevers in the general population were very rare at that time.⁴⁴

The introduction of indigenous malaria by United States troops in the 1850s was not a transitory phenomenon. Evidently, the subsequent increase in population throughout New Mexico, and especially in the Mesilla Valley, allowed critical levels of the various malaria transmission factors to be maintained. Malaria became firmly established and extended its range northward. In the early years of the twentieth century, malaria was extremely common throughout the Río Abajo. In the 1920s, malaria was highly prevalent in the Mesilla Valley, and a major epidemic in 1927 caused Governor Richard C. Dillon to ask for expert help from the United States Public Health Service. As late as 1941, indigenous malaria occurred as far north as Española.⁴⁵

New Mexico, as well as the rest of the United States, is now free of indigenous malaria. Most experts agree the prospects for its re-establishment are remote and the subject is only occasionally popular (as a consequence of imported cases) in the American public health literature.⁴⁶ Perhaps Fort Thorn, which generally warrants only a brief footnote in history, should be remembered as an important origin of a serious 100-year problem for New Mexico.

NOTES

1. Robert W. Frazer, *Forts of the West: Military Forts and Presidios and Posts Commonly Called Forts West of the Mississippi River to 1898* (Norman: University of Oklahoma Press, 1965), 104; John Russell Bartlett, *Personal Narrative of Explorations and Incidents in Texas, New Mexico, California, Sonora, and Chihuahua, 1850-1853*, 2 vols. (1854; Chicago, Illinois: Rio Grande Press, 1965), 1:217.

2. Hubert Howe Bancroft, *History of Arizona and New Mexico, 1530-1888* (Albuquerque, New Mexico: Horn & Wallace, 1962), 656; A.B. Bender, "Frontier Defense in the Territory of New Mexico, 1853-1861," *New Mexico Historical Review* 9 (October 1934), 345-73.

3. Colonel George Archibald McCall, *New Mexico in 1850: A Military View*, ed. Robert W. Frazer (Norman: University of Oklahoma Press, 1968), 4; A.B. Bender, "Military Posts in the Southwest, 1848-1860," *New Mexico Historical Review* 16 (April 1941), 134.

4. Quote from United States Congress. Senate. *Statistical Report on the Sickness and Mortality in the Army of the United States. . . 1855 to 1860*. 36th Cong., 1st sess., 1860. Sen. Ex. Doc. 52. Serial 1035 (Washington, [D.C.]: George W. Bowman, 1860), 224 (hereafter *SGR, 1860*); Frazer, *Forts of the West*, 104.

5. Russell L. Cecil and Robert F. Loeb, eds., *A Textbook of Medicine*, 8th ed. (Philadelphia, Pennsylvania: W.B. Saunders, 1951), 18, 84, 205; Thomas H. Maugh II, "A Malaria Primer," *Science* 196 (22 April 1977), 414.

6. *SGR, 1860*, p. 225; Myrtle Greenfield, *A History of Public Health in New Mexico* (Albuquerque: University of New Mexico Press, 1962), 6; Maxine O. Dellinger, "Milestones in the Medical History of New Mexico," *Rocky Mountain Medical Journal* 59 (November 1962), 31-35.

7. Marc Simmons, "New Mexico's Smallpox Epidemic of 1780-1781," *New Mexico Historical Review* 41 (October 1966), 319-26; Oswald G. Baca, "Analysis of Deaths in New Mexico's Rio Abajo During the Late Spanish Colonial and Mexican Periods, 1793-1846," *New Mexico Historical Review* 70 (July 1995), 237-55.

8. United States Congress. Senate. *Statistical Report on the Sickness and Mortality in the Army of the United States Compiled from the Records of the Surgeon General's Office. . . 1839 to 1855*. 34th Cong., 1st sess., 1856. Sen. Ex. Doc. 96. Serial 827 (Washington, [D.C.]: A.O.P. Nicholson, 1856), 432-35, 488-93 (hereafter *SGR, 1856*); *SGR, 1860*, pp. 230-33, 322-24.

9. *SGR, 1856*, pp. 432, 488.

10. *Ibid.*, p. 413.

11. McCall's Inspection Reports, reprinted in Colonel George Archibald McCall, *New Mexico in 1850*, pp. 111-76, include Santa Fe, Abiquiu, Taos, Las Vegas, Rayado, Albuquerque, Cebolleta, Socorro, Doña Ana, El Paso, and San Elizario. Only Taos had no physician at the time of inspection.

12. *SGR, 1856*, p. 5.
13. *SGR, 1860*, p. 223.
14. *Ibid.*, p. 224.
15. *Ibid.*
16. Paul F. Russell, "The United States and Malaria: Debits and Credits," *Bulletin of the New York Academy of Medicine* 44 (June 1968), 624.
17. *Ibid.*, p. 626.
18. Max L. Moorhead, *New Mexico's Royal Road: Trade and Travel on the Chihuahua Trail* (Norman: University of Oklahoma Press, 1958), 20, 112.
19. Paul F. Russell, "The United States and Malaria," 628-31.
20. Richard H. Coolidge, an army surgeon, who compiled the statistical reports from the primary data received from the post surgeons, stated that the utility of compiling the original reports "would not be commensurate with the very great amount of labor necessary to their compilation" (*SGR, 1856*, p. 4). Specifically concerning the New Mexico department, he stated, "To the frequent movement of troops from one point to another, and the almost constant field service of a majority of the medical officers, is attributed the absence of medico-topographical reports from the military stations in New Mexico" (*SGR, 1856*, p. 413).
21. *SGR, 1860*, p. 218.
22. Wilbur G. Downs, "Malaria: The Great Umbrella," *Bulletin of the New York Academy of Medicine* 51 (September 1975), 984-90.
23. *SGR, 1856*, p. 425; *SGR, 1860*, pp. 215, 223-25. In the report on Fort Buchanan, assistant surgeon B.I.D. Irwin stated to the effect that quinine was completely effective for new cases, but "after frequent attacks availed but little" (*SGR, 1860*, p. 215). This point would tend to augment confidence that the rapid increase in incidence shown in figure 1 between 1855 and 1858 represented new cases of malaria to a very large extent rather than having other diseases extensively embedded in the numbers (see note 26).
24. Russell L. Cecil and Robert F. Loeb, eds., *A Textbook of Medicine*, 18, 84, 205.
25. This effort is reported in considerable detail as an appendix in *SGR, 1856*, pp. 637-90.
26. "Incidence" is defined as the number of cases of a disease occurring per unit time, which means the proportion of a population which is suffering from a particular disease at any given time. In figure 1, the incidence is per year and is considered to be a relative incidence because the data contain an unknown proportion of cases that represent recurrence of symptoms rather than new cases. This proportion should be relatively minor during periods of greatest rate increase, but was probably very large in New Mexico during the period 1849-54, when cases tended to represent new recruits coming from malarious regions elsewhere. "Mean strength" is given as reported by the post surgeons and represents the average number of troops at the given post over a three-month period. Here again, the data tends to minimize the fluid nature of the number of troops at any given site during this period. This fact alone makes it obvious that Fort Thorn could not have been the only fort to have any cases, as was illustrated above by Henry's description of what happened to the visiting regimental band.
27. T.M. Pearce, ed., *New Mexico Place Names: A Geographical Dictionary* (Albuquerque: University of New Mexico Press, 1965), 58.
28. George Rutledge Gibson, *Journal of a Soldier Under Kearny and Doniphan, 1846-1847*, ed. Ralph P. Bieber (Glendale, California: Arthur H. Clark Company, 1935), 163-64, 255; *SGR, 1856*, pp. 416, 426.
29. Louis L. Williams, Jr., "Malaria Eradication in the United States," *American Journal of Public Health* 53 (January 1963), 17.

30. Bernal Diaz, *The Conquest of New Spain* (Baltimore, Maryland: Penguin Books, 1963), 155; Ignaz Pfefferkorn, *Sonora: A Description of the Province*, trans. Theodore E. Treutlein (Albuquerque: University of New Mexico Press, 1949), 213; Pedro Alonso O'Crouley, *A Description of the Kingdom of New Spain: 1774* (Dublin, Ireland: Allen Figgis, 1972), 45; F.W. Hodge, "A Virginian in New Mexico in 1773-1774," *New Mexico Historical Review* 4 (July 1929), 239-72; W.W.H. Davis, *El Gringo: Or, New Mexico and Her People* (1857; Chicago, Illinois: Rio Grande Press, 1962), 151; A. Wislizenus, *Memoir of a Tour to Northern Mexico, 1846-1847: Connected with Colonel Doniphan's Expedition in 1846 and 1847* (Albuquerque, New Mexico: Calvin Horn Publishers, Inc., 1969), 25; *Abert's New Mexico Report, 1846-'47* (Albuquerque, New Mexico: Horn & Wallace, 1962), 126; John Russell Bartlett, *Personal Narrative*, 1:408.

31. *SGR, 1860*, p. 213. An interesting description of the town of Tucson, written by an anonymous correspondent for the San Francisco *Daily Evening Bulletin*, 19 November 1858, was brought to the author's attention by John P. Wilson. In regard to the health of the residents, the correspondent wrote: "His must be a constitution of iron that can long resist the deleterious attacks of the climate of this tail-end of creation. Chills and fever are very prevalent. Everything here, from the hairless dog to the savage mortal, seems ever to be complaining. The blankets that cover us at night shake, the walls shake, the stools shake, the legs of most men I see here shake to such a degree that the buttons are lost from the pants. . . . The water, the air, liquor, and the very fire, have ague in them. Here, it is almost a labor to live—so say the poor devils whom I daily see tottering along the dusty streets with shaking shadows."

32. Robert W. Frazer, *Forts and Supplies: The Role of the Army in the Economy of the Southwest, 1846-1861* (Albuquerque: University of New Mexico Press, 1983), 123, 127, 183.

33. *SGR, 1860*, p. 207.

34. Arturo Castiglioni, *A History of Medicine*, trans. and ed. E.B. Krumbhaar, 2d ed. (New York: Alfred A. Knopf, 1947), 809-29; Paul E.M. Fine, "Ross's *a priori* Pathometry—A Perspective," *Proceedings of the Royal Society of Medicine* 68 (September 1975), 547.

35. Robert Matheson, *Handbook of the Mosquitoes of North America*, 2d ed. (1929; Ithaca, New York: Comstock Publishing Company, Inc., 1944), 44-46; Paul F. Russell, Luther S. West, Reginald D. Manwell, and George MacDonald, *Practical Malarology*, 2d ed. (1946; London, England: Oxford University Press, 1963), 176-78; Maurice T. James and Robert F. Harwood, *Herms's Medical Entomology*, 6th ed. (London, England: Macmillan Company, 1969), 201.

36. Paul E.M. Fine, "Ross's *a priori* Pathometry," 548.

37. Maurice T. James and Robert F. Harwood, *Herms's Medical Entomology*, 201, 203.

38. In 1853, assistant surgeon E.P. Langworthy stated that there were no habitations or cultivated land in the Rio Grande Valley for 100 miles south of San Antonio, 12 miles south of Socorro (*SGR, 1856*, p. 417); George Ruxton, *Adventures in Mexico and the Rocky Mountains* (1847; Glorieta, New Mexico: The Rio Grande Press, Inc., 1973), 171; Colonel George Archibald McCall, *New Mexico in 1850*, 93.

39. *SGR, 1860*, p. 225.

40. Frazer, *Forts and Supplies*, 62, 92.

41. *SGR, 1856*, pp. 415, 425.

42. *SGR, 1860*, pp. 322-28.

43. *Ibid.*, pp. 230-33.

44. *SGR, 1856*, pp. 415, 425, 427. Recent epidemiological studies of the Río Abajo in the Mexican period have shown that a high proportion of total mortality was from epidemics of respiratory infections in children, possibly including whooping cough (pertussis). See Oswald G. Baca, "Analysis of Deaths in New Mexico," 245. At Fort Defiance it was noted that a major epidemic of rubeola killed many Navajos in 1845 (*SGR, 1856*, p. 427).

45. Myrtle Greenfield, *A History of Public Health in New Mexico*, 33, 79, 84, 86-87, 138; Florence Hawley Ellis, "Tome and Father J.B.R[alliere]," *New Mexico Historical Review* 30 (July 1955), 217.

46. James J. Gibson, Richard E. Brodsky, and Myron G. Schultz, "News From the Center for Disease Control: Changing Patterns of Malaria in the United States," *Journal of Infectious Diseases* 130 (November 1974), 553-55; Louis L. Williams, Jr., "Malaria Eradication in the United States," 17-21.