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SUMMARY: This article examines major epidemics of bacillary dysentery in the German army as well as among civilians in eastern Europe and in Germany during World War I. These epidemics were all the more surprising in light of prewar advances in understanding the disease and limiting dysentery outbreaks. Three major reasons are adduced for the incapacity of German military hygienists to prevent wartime epidemics. First was the difficulty of bacteriological testing at the front, especially early in the war, with negative consequences for diagnosis, therapy, and disease control. Second was inadequate hygiene including major shortcomings in latrine cleanliness and attempts to grapple with the "fly plague." Third was the lack of a Pasteur-type vaccine until late in the war. Susceptibility to dysentery was also heightened by war-related nutritional deficiencies. Taking off from an article by the English medical historian Roger Cooter, this article shows that the concept of "war dysentery" was socially constructed and served a variety of professional interests but at the same time takes issue with Cooter's arguments against linking "war" and "epidemics" pathogenetically.

KEYWORDS: bacillary dysentery, bacteriology, military hygiene, vaccines, serum therapy, World War I, war and epidemics

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In the fall of 1919 Wilhelm Hoffmann (b.1872), a leading bacteriologist and advisory hygienist to a German army group on the eastern front during World War I, published an article in Germany's military medical journal evaluating the hygienic experience of the war.[1] This article largely celebrated the role of advisory hygienists like himself, whom he claimed had been able to maintain satisfactory hygienic conditions under extremely difficult circumstances through their assiduous efforts. Hoffmann also briefly analyzed interventions to prevent or limit infectious diseases including cholera, typhoid, epidemic typhus, and STDs. He concluded that by combining specific prophylactics like typhoid and cholera vaccines with general sanitary measures, they had succeeded in "keeping all too great suffering from our army and homeland."[2] Most medical historians who have examined the hygienic policies implemented by the military medical corps to control infectious diseases during the Great War generally have concurred with Hoffmann's assessment.[3]

Hoffmann did acknowledge several failures, however, the most important of which was the inability to contain outbreaks of bacillary dysentery.

> Dysentery was really a war epidemic in many theaters of war! At certain times it emerged so massively both on moving and static fronts that hospitals were overwhelmed with dysentery patients and the necessity of expanding hospitals posed difficult organizational problems for doctors. Often one achieved no satisfactory success despite conscientious latrine hygiene and the most energetic combating of flies. Whether climatic influences or dietary deficiencies, especially the consumption of fresh or moldy bread or other spoiled food, had special etiological significance could not be determined with certainty. Bacteriologically there were certainly a number of pure Flexner or Shiga epidemics; mostly, however, various types of dysentery bacilli were found. . . . One can boldly assert that during the war essentially bacteriology didn't advance our knowledge of the etiology of dysentery.[4]

1. Wilhelm Hoffmann, "Hygienische Erfahrungen, Infektionskrankheiten und Schutzimpfung im Weltkriege," *Deutsche Militärärztliche Zeitschrift* 48 (October 1919): 209–25.

2. Ibid., 225.

3. For example, J. D. C. Bennett, "Medical Advances Consequent to the Great War 1914–18," *J. Roy. Soc. Med.* 83 (1990): 738–42 and Wolfgang U. Eckart, "'Der grösste Versuch, den die Einbildungskraft ersinnen kann'—Der Krieg als hygienisch-bakteriologisches Laboratorium und Ehrfahrungsfeld," in *Die Medizin und der ersten Weltkrieg*, ed. Wolfgang U. Ekart und Christoph Gradmann (Pfaffenweiler, Germany: Centaurus Verlagsgesellschaft, 1996), 299–319.

4. Hoffmann, "Hygienische Erfahrungen" (n. 1), 219–20.

He also regretted that "in the interests of scientific research and popular health" projects to develop a dysentery vaccine had not been initiated earlier and fostered more vigorously.[5]

Although Hoffmann's account was restricted to the German military, as we shall see, bacillary dysentery epidemics struck civilian populations in the war zones and occupied territories of eastern Europe as well as in Germany itself, especially during the summer of 1917, resulting in thousands of deaths. Indeed, as the eminent cardiologist Wilhelm His (1863–1934) noted in the 1928 Carnegie volume on health in Germany during the war, "In any event, bacillary dysentery was the only war epidemic that attained a substantial spread and claimed a notable number of victims."[6]

This article explores the major reasons for these unanticipated epidemics that contrasted so markedly with the low incidence of such enteric diseases as typhoid and cholera throughout the war. The emergence of bacillary dysentery as a prevalent and lethal wartime disease seemed all the more stunning in light of the substantial research and the application of control measures that took this research into account, which had relegated bacillary dysentery to marginal significance as a public health issue in Germany between 1900 and 1914. Three reasons for the inability to prevent dysentery are highlighted, all of which were adumbrated in the Hoffmann quote above. First were the difficulties with bacteriological diagnosis encountered during the war. These diagnostic problems had consequences for both therapeutics and disease transmission. They also crystallized professional tensions between bacteriologically trained hygienists and clinicians. Second were impediments to implementing effective latrine hygiene and fly control under wartime conditions especially on the eastern front. Third was the lack of Pasteur-type vaccine comparable to those available for cholera and typhoid until very late in the war. Susceptibility was also heightened by nutritional deficiencies, which were especially pronounced during the summer of 1917. As is shown, the relative significance of these reasons shifted both geographically and temporally.

Finally, this article engages some of the issues raised by Roger Cooter in his article "Of War and Epidemics: Unnatural Couplings, Problematic Conceptions."[7] There Cooter sought to deconstruct the supposedly

5. Ibid., 220.

6. Dr. Wilhelm His, "Abdominaltyphus, Paratyphus, Ruhr, Masern, Scharlach, Keuchhusten, Diphtherie, Rückfallfieber, Malaria, Trichinose, Tollwut, Encephalitis Lethargica, Wolhynisches Fieber," in *Deutchlands Gesundheitsverhältnisse unter dem Einfluss des Weltkrieges Bd. I*, ed. Dr. F. Bumm (Stuttgart: Deutsche Verlags-Anstalt, 1928), 358–59.

7. Roger Cooter, "Of War and Epidemics: Unnatural Couplings, Problematic Conceptions," *Soc. Hist. Med.* 16, no. 2 (2003): 283–302.

natural association between war and epidemics by critically scrutinizing the discourses about this dyad and exposing the succession of professional and ideological interests that it served particularly in nineteenth- and twentieth-century Britain. Cooter's article largely traced the intellectual history of this terminological coupling. Here it is argued that the concept of "war dysentery" was certainly entangled with manifold professional, personal, and political interests. Cooter went further, however, and attempted to discredit the association between war and epidemics. This runs counter to an extensive body of medical historical literature that established this linkage, from Friedrich Prinzing's classic *Epidemics Resulting from Wars* (1916) to the massive recent volume by M. R. Smallman-Raynor and A. D. Cliff, *War Epidemics: An Historical Geography of Infectious Diseases in Military Conflict and Civil Strife, 1850–2000* (2004). Prinzing emphasized the seriousness of dysentery in major nineteenth-century wars including the Crimean War, the American Civil War, and the Franco–Prussian War. Apart from dysentery, both bacillary and amebic, Prinzing highlighted cholera, smallpox, plague, epidemic typhus, typhoid, and scurvy, the latter of which he believed probably to be caused by an infective agent because of widespread outbreaks, as diseases frequently associated with wars.[8] In addition to the diseases featured in Prinzing, Smallman-Raynor and Cliff included influenza, malaria, measles, relapsing fever, tuberculosis, and yellow fever.[9] Cooter was certainly right to argue that the association between wars and particular epidemics need to be demonstrated rather than assumed, but much of this literature has carefully specified distinctive wartime conditions that facilitated epidemics. Here it is argued that the relation between the First World War and pervasive bacillary dysentery epidemics should be conceived pathogenetically, as the widely used neologism "war dysentery" implied. Moreover, recent research on such diseases as malaria, typhus, and influenza reinforce the conclusion that conditions generated by the First World War were causally related to major epidemics, research that is discussed at the end of this article.

Bacillary Dysentery Research and Control before the War

Today bacillary dysentery or shigellosis is understood as an acute oral-fecal transmitted bacterial infection caused by four different bacterial sero-

8. Friedrich Prinzing, *Epidemics Resulting from Wars* (Oxford, UK: Clarendon, 1916), 4–10.

9. M. R. Smallman-Raynor and A. D. Cliff, *War Epidemics: An Historical Geography of Infectious Diseases in Military Conflict and Civil Strife, 1850–2000* (Oxford, UK: Oxford University Press, 2004), 35–39.

groups with numerous subtypes, the most dangerous of which is *Shigella dysenteriae*.[10] The disease attacks the small intestines and colon, producing swelling, ulcerations, and micro-lesions. Symptoms usually include fever, nausea, vomiting, cramps, tenesmus, and loose, watery stool often suffused with blood, pus, and mucus. As many as twenty bowel movements daily are common, often giving rise to severe dehydration. The incubation period usually varies from two to three days, although it can be as long as a week, and the disease may last from several days to three weeks. Serious complications range from toxemia to heart damage to rectal prolapse. Since bacillary dysentery flourishes wherever there is overcrowding and contaminated water and food sources, it remains a major killer in sub-Saharan Africa and in south Asia resulting in hundreds of thousands of deaths annually, especially among infants. Many of the modern understandings of bacillary dysentery were developed by medical bacteriologists at the turn of the twentieth century.

In 1898 as the culmination of an extensive research project on dysentery in Japan the Kitasato associate and bacteriologist Kiyoshi Shiga (1871–1957) announced the discovery of the bacillus that bears his name, although he originally claimed that it was motile.[11] Apparently independently, two years later Walther Kruse (1864–1943), a hygienist and bacteriologist at the University of Bonn, isolated a nonmotile bacillus during an epidemic in an industrial town in the Ruhr Valley in western Germany. A commission convened by Robert Koch (1843–1910) to resolve the heated priority dispute between Shiga and Kruse determined that the bacilli were the same although nonmotile. Consequently, in Germany the pathogen was designated the Shiga–Kruse bacillus. In the wake of the Spanish-American War the Johns Hopkins pathologist Simon Flexner (1863–1946) discovered another bacillus in the Philippines that caused dysentery-like symptoms. This finding was soon followed by the identification of several other closely related microbes that called forth similar

10. Good standard accounts include Gerald T. Keusch and Michael L. Bennish, "Shigellosis," in *Bacterial Infections of Humans: Epidemiology and Control*, 3rd ed., ed. Alfred S. Evans and Philip S. Brachman (New York: Plenum, 1998), 631–56 and "Shigellosis," in *Control of Communicable Disease Manual*, 18th ed., ed. David L. Heymann (Washington, D.C.: American Public Health Association, 2004), 487–88.

11. For the discovery of the various dysentery bacilli by Shiga, Kruse, and Flexner, see Simon Paul Hardy, "Investigating Bacillary Dysentery: The Role of Laboratory, Technique, and People," *Internat. J. Med. Microbiol.* 296 (2006): 171–74 and Hermann Lüdke, *Die Bazillenruhr* (Jena, Germany: Verlag von Gustav Fischer, 1911), 6–15, including an account of the priority dispute. *Die Bazillenruhr* was the standard pre–World War I German monograph on bacillary dysentery.

symptoms. Kruse soon distinguished the Shiga or "real" dysentery bacillus, which emitted a potent exotoxin, from those like the Flexner or Y bacilli, which were weakly toxic and which he, therefore, called "pseudo-dysentery bacilli." These latter he divided into numerous strains, which he labeled with letters, for example, A, B, and so on. Although many bacteriologists rejected Kruse's term "pseudo-dysentery bacilli" on the grounds that it implied they were nonpathogenic, nonetheless the basic division between the highly toxic and, hence, more virulent Shiga–Kruse bacillus and the less virulent Flexner strains gained universal acceptance.[12] Subsequently Kruse and other bacteriologists were able to differentiate these various bacilli based on morphology, chemical behavior in various agar solutions, and sero-agglutination tests.[13] By 1914 the diagnosis of bacillary dysentery, although often technically difficult, was perceived as being routine and reliable. Not only could standardized laboratory procedures confirm or refute clinical diagnoses, but repeated testing of recuperating patients could prevent the premature release of still infectious convalescents and detect asymptomatic carriers, a major concern of the period.

In the decades after German unification in 1871 serious summer dysentery epidemics had been common with mortality rates between 20 percent and 50 percent among infants and the elderly, especially in the Rhine-Ruhr industrial district and the agrarian districts of the Prussian east.[14] In the Rhenish textile city of Barmen, for example, there were 409 cases during 1900 and 474 during 1901.[15] Both general sanitary measures such as improvements in sewer systems as well as specific ones including the mandatory hospitalization of those diagnosed with dysentery and disinfection of their effects and immediate surroundings soon reduced incidence and mortality. Whereas 1,950 persons officially died of dysentery in Prussia in 1895, Germany's largest state, and 1,206 in 1899, by 1912 Prussia registered only 98 deaths.[16] In Hamburg, where medical reporting of cases was legally obligatory, only a handful of cases, mostly sailors,

12. For critiques of Kruse's terminology and his reply to his critics, see W. Kruse, "Über die Ruhr," in *Verhandlungen der ausserordentlichen Tagung des Deutschen Kongresses für Innere Medizin in Warschau am 1. und 2. Mai 1916*,ed. W. His and W. Weintraud, 303–4.

13. For a thorough account of the various diagnostic tests available, see Lüdke, *Bazillenruhr* (n. 11), 20–43. A table summarizing the various methods appears on 33–35. The agglutination tests are considered in far greater technical detail on 166–90.

14. W. Kruse, "Über die Ruhr" (n. 12), 302.

15. Lüdke, *Bazillenruhr* (n. 11), 193–95, 219–23.

16. Karl E. Boehncke, "Bazillenruhr," in *Hygiene*, vol. 7, ed. Wilhelm Hoffmann, *Handbuch der Ärztlichen Erfahrungen im Weltkriege 1914/1918*, ed. Otto von Schjerning (Leipzig: Verlag von Johan Ambrosius Barth, 1922), 360–85, esp. 374.

were recorded annually during the immediate prewar years.[17] There was undoubtedly considerable underreporting. One study in Berlin noted that although only five cases of bacillary dysentery came to official attention in 1911, among the 628 blood tests the municipal laboratory carried out for various reasons, 130 tested strongly positive for Y-dysentery bacilli and the agglutination reactions of an equal number indicated the presence of Y-antibodies.[18] Presumably, however, the symptoms of those tested had been so mild that they had not sought medical treatment. Despite dark numbers there can be little doubt about the sharp decline in morbidity and mortality in Germany after 1900.

As one staff doctor wrote in 1914, only among military personnel had there been numerous cases in the prewar years.[19] Two typical incidents reported in detail in the military medical press were epidemics in the army garrison in Metz in Alsace during the summer of 1910 and one on an army base near Stuttgart three years later.[20] The former consisted of two distinct epidemics: the first an epidemic of shigellosis in July that was traced to a carrier and only affected one unit and the second a Y-bacillus epidemic that infected more units and ultimately sickened almost 350 soldiers. Y-bacilli were also the causal agents in the Stuttgart epidemic in which 52 soldiers were hospitalized. In both instances military doctors responded energetically to keep the disease from spreading. Dysentery patients, those suspected of having dysentery, and asymptomatic carriers were sequestered in separate hospital wards and not released until three successive stool samples proved negative. The patients' beds, clothes, and personal effects were sterilized. Sanitary officers tested kitchen and canteen workers as well as those housed in the same barracks as the stricken. They educated troops about dysentery and enforced heightened sanitary precautions including requiring soldiers to wash their hands with cresol solution after using the latrines and before meals. Barracks were cleaned thoroughly and latrines disinfected with quicklime. Contacts with civilians were minimized. In Metz those who had recovered were tested again the

17. Jos. Koch, "Zur Epidemiologie und Bekämpfung der Ruhrerkrankungen im Felde," *Deutsche med. Wochenschr.* 42 (February 12, 1916): 183–88, esp. 184.

18. Otto Mayer, "Über die Verbreitung der Y-Dysenteriebazillen," *Feldärztliche Beilage zur Münch. med. Wochenschr.* (September 1, 1914): 1887.

19. Ibid., 1886.

20. K. E. Boehncke, "Die Ruhrepidemie im Standort Metz im Sommer 1910," *Deutsche militärärztliche Zeitschr.* 40 (1911): 803–17; and Bofinger, "Über eine durch den sog. Y-Bazillus hervorgerufene Ruhrepidemie," *Deutsche militärärztliche Zeitschr.* 43 (1914): 141–47.

following winter to make sure that they had not become carriers. Consequently, the epidemics were extinguished rapidly. Such incidents certainly showed that military bases were still vulnerable to outbreaks of bacillary dysentery, but they also inspired confidence that the speedy deployment of bacteriologically informed hygienic procedures could contain them both temporally and spatially.

Although treatment still relied primarily on bed rest, bland diet, and rehydration, there was one major therapeutic breakthrough in the prewar period. First, Shiga in 1901 and then Kruse in 1903 experimented with antitoxin serum therapy modeled on that for diphtheria, experiments supposedly crowned with success especially when serum was administered during the early phase of the disease.[21] Serum was even tested on a few patients during the Russo-Japanese War. According to Kruse, as a result of serum injections "the severity of the disease was diminished, the length of the sickness and convalescence shortened, the number of fatalities decreased."[22] There were still problems with standardization, however, as well as questions about optimal dosage. Dysentery researchers, nonetheless, agreed that this etiological therapy produced beneficial outcomes. Serum therapy worked only for shigellosis, however, since only the Shiga bacillus emitted a potent toxin. Consequently precise bacteriological diagnosis was a necessary prerequisite for prescribing serum therapy.

A number of researchers, including Shiga and Kruse, had attempted to develop vaccines against both the Shiga and Flexner bacilli. Some used live virulent bacilli, others inactivated dead bacilli, and still others bacteria free filtrates.[23] These experimental vaccines had been tested on only a handful of human subjects, and most either provoked severe adverse reactions or failed to immunize. Moreover, because of the decline in dysentery morbidity and mortality in Germany there was little incentive to continue such research.

Epidemics during the War

Almost from the beginning of the war, dysentery epidemics and mortality began to increase markedly. Indeed, so sharp was the discontinuity with the prewar experience that by early 1915 the neologism "war dysentery"

21. Lüdke, *Bazillenruhr* (n. 11), 70–85.
22. Ibid., 70.
23. Ibid., 112–34.

(*Kriegsruhr*) was becoming commonplace in the German medical press.[24] Already during August 1914 German soldiers with bacillary dysentery began filling field hospitals on both the eastern and western fronts.[25] As one doctor affiliated with the Institute for Infectious Diseases, "Robert Koch," in Berlin wrote, "It was this infectious disease from which the troops of the *Landwehr* [national guard] corps suffered almost exclusively in the months of August, September, and October. For self-evident reasons I am not permitted to publish the numbers of sick here, but I can certainly say that the numbers of those ill with dysentery far surpassed the numbers of typhoid cases that occurred in all the months of campaigning during 1914."[26] In keeping with this account dysentery was predominantly a summer disease with cases concentrated between July and September, although there were few months that were entirely free of dysentery cases.[27] According to the official sanitary report, which was not published until 1934, ultimately 155,000 soldiers were hospitalized with bacillary dysentery during the war.[28] This tremendously understates actual incidence. Many soldiers with mild cases probably never sought medical treatment, and others were treated at the front and remained ambulatory. Doctors at the front, who were overburdened, sometimes neglected to report such cases.[29] Another factor contributing to underreporting was the difficulty of bacteriological diagnosis, which is discussed extensively below. Because of this difficulty some clinicians resorted to other diagnostic categories such as hemorrhagic colitis, stomach catarrh, or summer diarrhea, especially when symptoms were mild, although there was a consistent correlation between the frequency of these enteric conditions and dysentery

24. Among the earliest usages of the concept of "Kriegsruhr" seems to have been Soldin, "Zur Klinik der Kriegsruhr," *Deutsche med. Wochenschr.* 41 (January 14, 1915): 62–65. See also, e.g., M. Matthes, "Über die Ruhr," in His and Weintraud, *Verhandlungen* (n. 12), 283. "Wir wollen hier doch nur von Kriegsruhr sprechen."

25. For the eastern front see Marian Gleszcykiewicz, "Über die Ruhrepidemie 1914/15 auf Grund des Spitalmaterials," *Med. Klinik* (October 24, 1915): 1184–85. For the western front see *Sanitätsbericht über das Deutsche Heer im Weltkriege 1914/18*, vol. 3, *Die Krankenbewegung bei dem Deutschen Feld-und Besatzungsheer* (Berlin: Verlag von E.S. Mittler & Sohn, 1934), 127.

For those not familiar with the geography of the various campaigns, Martin Gilbert's *Atlas of World War I* (New York: Oxford University Press, 1994) is an excellent place to start.

26. Koch, "Zur Epidemiologie" (n. 17), 184.

27. On the seasonality of bacillary dysentery during the war, see Boehncke, "Bazillenruhr" (n. 16), 364–66.

28. *Sanitätsbericht* (n. 25), 125.

29. Viktor Gegenbauer, "Zur Kenntnis der Ruhr des östlichen Kriegsschauplatzes," *Archiv für Hygiene* 88 (1919): 219–20.

epidemics.[30] It is highly likely, moreover, that cases were overlooked on the western front during the summer of 1918 when German armies were in retreat and beginning to disintegrate in the aftermath of their failed spring and early summer offensives.[31]

No front was spared, but not surprisingly given Europe's west–east hygienic gradient, the vast majority of cases occurred on the eastern front and in the Balkans, although this was also partially attributable to the mobility of these fronts, which did not allow the kind of systematic hygienic organization that was standard in more stable sectors of the western front. In contrast to both typhoid and cholera, both of which declined in incidence and mortality as the war continued, dysentery morbidity rose dramatically over the course of the war, peaking during the summer of 1917.[32] Thus, one army on the eastern front registered 5,389 cases in 1915, 14,480 in 1916, and 20,751 in 1917. There were far fewer cases in 1918 (4,672) when fighting had largely ceased and troops were being transferred to the west.[33] Moreover, given looting from occupied Russian territories, the military food supply may well have been larger than in the previous year. During August 1917 six of every thousand Germans fighting on the eastern front were incapacitated with dysentery.[34] The reasons for this extremely high incidence were undoubtedly overdetermined. The summer of 1917 was particularly hot and dry, swarms of flies were ubiquitous, and heavy fighting was followed by rapid German advances as the Russian army began its terminal decline in the wake of the disastrous July offensive.[35] Conditions at the front defined a situation in which hygiene inexorably deteriorated. Indeed, dysentery morbidity tended to spike during major battles because of unavoidable hygienic breakdowns and the exhaustion and stress of soldiers which lowered

30. Th. J. Bürgers, "Über Ruhr im Felde," *Zeitschr. für Hygiene und Infektionskr.* 88 (1919): 13–40, esp. 16–20; Kruse, "Über die Ruhr" (n. 12), 301.

31. It is notable that the graph in the final sanitary report *Sanitätsbericht* (n. 25), 126 breaks off in July 1918 when the army began its major retreat, the month when major outbreaks of dysentery usually began.

32. According to the official sanitary report there were 116,481 cases of typhoid during the war, which resulted in 2,347 deaths. Over two-thirds of these cases, however, occurred during the first two years of the war. Despite fears about cholera epidemics, there were only 3,303 cases and 72 deaths. In the last two years of the war fewer than 200 cases were reported. *Sanitätsbericht* (n. 25), 99–112, 129–34.

33. Boehncke, "Bazillenruhr" (n. 16), 361.

34. *Sanitätsbericht* (n. 25), 126.

35. See, e.g., Holger Herwig, *The First World War: Germany and Austria-Hungary 1914–1918* (London: Arnold, 1997), 334–35.

resistance.[36] These advances, moreover, were accompanied by difficulties with food supply.[37] Furthermore, caloric intake had reached its minimum in the German army during 1917, and protein and fat content were significantly reduced.[38] Nutritional deficiencies undoubtedly heightened susceptibility within the German army. Because of the severity of some of these epidemics, bacillary dysentery was the official cause of death of 8,646 soldiers, 5.6 percent of those hospitalized.[39]

Bacillary dysentery had been endemic in Russian Poland before the war, especially in the countryside and villages, but in the face of wartime conditions it clearly increased among the urban population. Dr. Gottfried Frey, the director of medical administration in German-occupied Russian Poland, noted that 20,444 cases and 4,551 deaths were recorded officially from 1915 through 1917, although he recognized that the statistics were defective since many milder cases in the villages were accepted by the inhabitants as normal and, hence, eluded official attention.[40] Again the summer of 1917 was particularly bad, with 14,154 cases and 3,711 fatalities. An epidemic in Warsaw accounted for 45 percent of these cases and 62 percent of the deaths (2,313). Frey admitted that in addition to the summer heat, food shortages among the poorer sectors of the population that led to a "certain malnutrition" might well have constituted a predisposing condition. Nonetheless, Frey, who characteristically attributed health problems to the legacy of abysmal Russian administration and the cultural backwardness of Poles and Jews, offered an apologia for the German occupation policies. He emphasized the construction of special dysentery hospitals and wards to isolate the sick and suggested that this accounted for why under German administration there had not been the sort of countrywide epidemics commonplace under the Russians.

Bacillary dysentery rapidly returned to the German homeland as a major infectious disease when soldiers on leave transmitted it from the front. The following report from Bavaria in December 1916 portrays the infection of a village by a returning soldier.

36. Paul Jungmann and Emil Neisser, "Zur Klinik und Epidemiologie der Ruhr," *Med. Klinik* 13 (February 4, 1917): 123–24.

37. Herwig, *First World War* (n. 35), 335.

38. Dr. Merkel, "Die Gesundheitsverhältnisse im Heer," in Bumm, *Deutschlands Gesundheitsverhältnisse* (n. 6), 186–93, esp. 187–88.

39. *Sanitätsbericht* (n. 25), 125.

40. G. Frey, "Das Gesundheitswesen im Deutschen Verwaltungsgebiet von Polen in den Jahren 1914–18," in *Arbeiten aus dem Reichsgesundheitsamte* 51 (Berlin: Verlag Julius Springer, 1919), 671–73.

> In the commune of Roth in the county of Wellrichtstadt a dysentery epidemic has raged since the beginning of September of this year. According to information from the county doctor the first illness began on August 31. The first cases involved relatives of the national guardsman Adolf Link, who had diarrhea when he returned from Galicia on leave. Until now 45 illnesses from 20 families with 13 fatalities have been reported. 3 of the sick from 3–5 years old, 4 from 5–10, 3 from 10–15, and 3 over 50 have died. The epidemic is receding. Only in one case could Shiga–Kruse bacilli be detected bacteriologically.[41]

Morbidity and mortality spiraled up in the Reich with each passing year. In 1914 there were 5,893 cases in Prussia and 6,235 cases in the Reich as a whole, with 565 deaths altogether; in 1915, 7,678 cases in Prussia and 8,210 in the Reich, with 2,702 deaths; in 1916, 8,847 cases in Prussia and 9,894 in the Reich, with 2,504 deaths.[42] There was an enormous increase in 1917, however, with 57,503 cases in Prussia and 60,157 in the Reich and a total of 17,582 deaths. During the summer of 1917, 10,305 cases were recorded in the industrial Ruhr alone.[43] The epidemic of 1917 swept through the entire Reich, although it was more pervasive and severe in the countryside than in the better prepared cities. In one small rural district of Baden adjacent to the spa city of Baden-Baden there were 123 cases of shigellosis and 20 deaths. As the two doctors who wrote an account of this local epidemic stated, "We certainly know that dysentery is not really a disease of cities with regular garbage removal, but rather settles much more in villages with intensive cattle rearing which brings the increase of the fly plague in its wake."[44] Despite their hygienic provisions, however, German cities certainly did not escape from the 1917 summer epidemic. Essen, the Ruhr steel city famous for the Krupp works, recorded almost 1,500 cases.[45] The paired Rhenish cities of Mannheim and Ludwigshafen with their chemical and motor industries endured major epidemics during August 1917.

41. HSTAB (KrA) Mkr 10083 Ruhr: Staatsministerium des Innern an das K. Staatsministerium des Koenigl. Hauses-und des Auessern, das Kaiserliche Gesundheitsamt, das K. Kriegsministerium, Muenchen 6 Dezember 1916. Betreff: Erkrankungen an Ruhr. Dr. Freiherr von Soden.

42. His, "Abdominaltyphus," in Bumm, *Deutschlands Gesundheitsverhältnisse* (n. 6), 359.

43. Heinrich Hennis, "Die Bazillenruhr im Ruhrkohlengebiet 1917 und die Ergebnisse bakteriologischer und serologischer Untersuchungen," *Zeitschr. für Hygiene und Infektionskr.* 87 (1918): 429–50, esp. 436.

44. E. Mayerhofer and A. v. Reuss, "Epidemiologische und klinische Beiträge aus der abgelaufenen Ruhrepidemie des Sommers 1917 in Baden-Leesdorf," *Med. Klinik* 14 (January 27, 1918): 79–84, quotation on 79.

45. Hennis, "Bazillenruhr im Ruhrkohlengebiet" (n. 43), 436.

> Originally a few isolated cases of dysentery emerged in Mannheim. The course of the disease during the first days was usually severe and often led to death. Neither the doctors nor nurses in the hospital there were spared. The number of cases of illness surpassed 1,000 including more than 70 fatalities.
>
> At the end of July cases of dysentery also emerged in Ludwigshafen, which increased daily. . . . So far 141 patients have been delivered to the infectious disease hospital of whom 4 died. . . . Among the patients in the infectious disease hospital 40 have been clinically and bacteriologically diagnosed with dysentery. Above all these involve the Shiga–Kruse bacillus, only occasionally the Flexner bacillus.[46]

Even Berlin was affected. Between May and September 1917, 312 patients were treated for dysentery or dysentery-like conditions, numbers that surpassed the average for recent decades by 50 to 60 percent.[47]

As in Warsaw one of the major reasons for the severity of this epidemic was undoubtedly the malnourishment of much of the population, malnourishment attributable to the British naval blockade, condemned as the "hunger blockade" in Germany, as well as German wartime agricultural and rationing policies.[48] This nationwide dysentery epidemic followed the notorious "turnip winter," so called because the potato harvest failed and turnips were mixed into even bread and marmalade. For much of the winter average caloric intake for adults had been around two thousand calories daily and body weight fell substantially. Protein sources were in especially short supply. Although the wealthy were able to supplement provisions with food obtained on the black market, this option was not available to much of the population. Given the well-established association between malnutrition and dysentery, there can be no doubt that both in Germany and eastern Europe the severe food shortage of 1917 was a major predisposing condition.

The number of cases of bacillary dysentery in the Reich almost halved to 31,205 in 1918 with 7,769 deaths, in part undoubtedly because of somewhat better harvests.[49] Still case incidence was three times higher than in 1916. Moreover, it was not until 1922 that morbidity returned to levels lower than those of 1914.

46. HSTAB (KrA) Mkr 10083 Ruhr: Wuerzburg 28.8.1917. Stellv. Korpsarzt II A.K. an das K. Kriegsministerium. Betreff: Rurherkrankungen.

47. A. Albu, "Die Darmerkrankungen des diesjährigen Sommers," *Deutsche med. Wochenschr.* 43 (October 25, 1917): 1351–53, esp. 1351.

48. These issues are discussed at length in Avner Offer's *The First World War: An Agrarian Interpretation* (Oxford, UK: Clarendon, 1989). See esp. 26–31, 45–68.

49. His, "Abdominaltyphus," in Bumm, *Deutschlands Gesundheitsverhältnisse* (n. 6), 359.

Problems with Bacteriological Testing

What went wrong? Why were military hygienists unable to contain and control bacillary dysentery as they had for other oral-fecal diseases including typhoid and cholera? First, under wartime conditions bacteriological testing proved to be highly unreliable, a state of affairs that not only placed in question the etiology of dysentery but also had practical consequences for disease control and therapeutics. One doctor, who undertook a kind of meta-analysis of thirty-nine articles on bacteriological testing of stool samples written during the war, found that the rate of detection ranged from 3.3 percent to 100 percent.[50] During 1915 when stool samples were often sent to laboratories distant from field hospitals, positive results varied between 3.3 percent on the low end and 45.5 percent on the high end. Even eminent bacteriologists sometimes failed to detect pathogens. For example, in 1916 Wilhelm Kolle (1868–1935), Germany's leading typhoid specialist, the coauthor of a standard bacteriology textbook, and an advisory hygienist to an army in Russian Poland, jointly wrote an article with a clinician in which he emphatically declared that they had been unable to find any bacilli recognized as causal agents of dysentery during a major epidemic in Galicia the previous summer.[51]

What accounted for this enormous variation in detecting dysentery bacilli and the frequent failure to find any at all? At the end of the war Dr. T. Bürgers, a staff doctor in the reserves, enumerated six major reasons, all of which had figured prominently in wartime discussions.[52] (1) Samples were often taken from patients late in the disease process when few bacilli were present. (2) Samples were often handled poorly before testing. For example, stool samples were often kept warm, which facilitated the proliferation of *E. coli* that were known to inhibit the growth of dysentery bacilli. (3) Over twelve hours often elapsed between taking a sample and testing during which the dysentery bacilli had been winnowed out by other bacilli. (4) The available agar was often of poor quality and unsuitable for cultivating dysentery bacilli. (5) In many instances patients suffered from mixed infections and other bacilli such as the proteus overwhelmed dysentery bacilli. (6) Bacterial diagnosis of dysentery demanded considerable skill and experience. The host of rapidly trained

50. Gegenbauer, "Zur Kenntnis" (n. 29), 222–24.

51. Dorendorf and W. Kolle, "Klinische und bakteriologische Beobachtungen über Ruhr während des Sommerfeldzuges einer Armee in Galizien und Russisch-Polen," *Deutsche med. Wochenschr.* 42 (May 11, 1916): 561–64, esp. 563.

52. Bürgers, "Über Ruhr im Felde" (n. 30), 28–31.

technicians, who staffed military hospital laboratories, often lacked "the capacity for exact, critical work." Some of these problems were addressed in the course of the war by adopting standardized procedures for transporting samples and considerably reducing the time between sampling and testing.[53] Indeed, because of the shortage of agar and the inability to find bacilli without rapid testing, the Medical Section of the Prussian War Ministry in Berlin cautioned bacteriologists against testing unless samples were brought fresh from the sick bed and also against further testing of patients if an epidemic had been shown to be caused by the less serious Flexner or Y-bacilli.[54] Consequently, by the end of the war bacteriological testing was considerably more reliable than at the outset. Nonetheless, not all the problems Bürgers listed could be solved.

Given the low rates of detection when testing stool samples early in the war, bacteriologists debated whether sero-agglutination tests should be preferred and whether or not they were more accurate.[55] These tests, however, also proved to be problematic. At best agglutination tests could show only retrospectively which bacilli had caused the symptoms, rather than being used for early diagnosis, since positive results did not appear until later stages of the disease. There were other impediments as well. Some bacteriologists found that the sera of soldiers inoculated against typhoid readily agglutinated dysentery bacilli, a serious drawback since all German troops were vaccinated against typhoid. Some strains of dysentery bacilli agglutinated in the sera of healthy patients; others did not agglutinate even in the sera of those who had been diagnosed bacteriologically with dysentery. Ulrich Friedmann (1877–1949), director of the infectious disease unit at Rudolf Virchow Hospital in Berlin, who had obtained positive results from stool samples in only 5 to 11 percent of suspected cases between 1915 and 1917, endorsed agglutination tests, especially to determine whether hemorrhagic colitis had been caused by dysentery bacilli, but also warned about their trickiness and limitations.

53. Boehncke, "Bazillenruhr" (n. 16), 372–73.

54. HSTAB (KrA) Mkr 10083 Ruhr. Kriegsministerium Medizinal-Abteilung, Berlin: 29.11.1916. Signed by Schultzen.

55. See L. Dünner, "Die Agglutination bei Ruhr und ruhrartigen Erkrankungen," *Berliner klin. Wochenschr.* (November 15, 1915): 1184–85; Lasar Dünner and Ilse Lauber, "Unterschiede in der Agglutinabilität verschiedener Ruhrstämme und deren Bedeutung für die serologische Diagnose der Ruhr," *Berliner klin. Wochenschr.* (November 20, 1916): 1266–67; P. Schmidt, "Zur Frage der Brauchbarkeit der Serum-Agglutination bei Ruhr," *Zeitschr. für Hygiene und Infektionskr.* 81 (1916): 57–62; R. Hamburger, "Untersuchung über Ruhr: II. Beitrag zur Diagnostik inagglutinabler Ruhrstämme," *Berliner klin. Wochenschr.* (August 6, 1917): 770.

> From a technical perspective it should be noted that agglutinability of dysentery strains is very uneven and inconstant, so that the greatest emphasis must be placed on the proper selection and control of strains. Only such cultures that clearly agglutinate in coarse clumps in patients' sera should be used. Distinguishing between Shiga and Y-dysentery on the basis of serum reactions is not always possible. It does happen that *the serum of Shiga dysentery patients exclusively agglutinate low toxin strains.*[56]

In light of these limitations, not surprisingly bacteriologists seldom resorted to agglutination tests during the war.

The unreliability of bacteriological diagnosis had several major consequences. First, doubts about the etiology of dysentery became widespread. For example, Kolle asserted that "Galician dysentery" was caused by none of the bacilli previously identified as dysentery pathogens and probably not by a bacillus at all.[57] A number of bacteriologists advanced claims for bacilli previously considered harmless including acid-forming capsule bacilli of the *B. lactis* group or mutant *E. coli.*[58] (Indeed, for the first time *E. coli* came to be considered potentially harmful, and some cases diagnosed as dysentery undoubtedly were caused by enteroinvasive strains of *E. coli.*) Several physicians revived the localist and miasmatic theories of Max von Pettenkoffer, a major nineteenth-century German sanitarian and outspoken critic of bacteriology.[59] According to his disciples dysentery arose from local dispositions related to infected soil. Bacteriologists conceded that epidemics often were localized but argued that "local disposition" resulted from infection of the ground by human feces laden with dysentery bacilli, which were then spread mechanically by flies rather than miasmas emanating from infected soil. Nonetheless, the fact that miasmatic notions could be resuscitated and taken seriously testifies to the destabilization of knowledge about the etiology of dysentery. In part the concept of "war dysentery" seems to have expressed this uncertainty.

56. U. Friedmann, "Bakteriologie der Ruhr," *Deutsche med. Wochenschr.* 43 (December 6, 1917): 1524–25, quotation on 1524; italics in original. See his earlier article as well for his endorsement of agglutination tests: Friedmann and Steinbock, "Zur Aetiologie der Ruhr," *Deutsche med. Wochenschr.* 42 (February 24, 1916): 215–18.

57. Dorendorf and Kolle, "Klinische und bakteriologische Beobachtungen" (n. 51), 564.

58. Friedmann and Steinbok, "Zur Aetiologie" (n. 56), 215–16; Czaplewski, "Ueber Ruhr," *Deutsche med. Wochenschr.* 43 (October 25, 1917): 1347–51.

59. Koch, "Zur Epidemiologie" (n. 17), 185–86; Boehncke, "Bazillenruhr" (n. 16), 362.

While some physicians nominated bacilli other than those commonly accepted as culprits before the war or revived miasmatic explanations, other doctors ascribed dysentery outbreaks to episodes of mass food poisoning, a position Hoffmann alluded to in the initial quote. Thus, during July 1915 a "dysentery-like" illness broke out in the Bavarian 6th Army near Lille.[60] Although the chief army doctor noted that numerous asymptomatic carriers had been detected since the previous fall and that in many cases bacilli of the weakly toxic dysentery group had been found, nonetheless since no pathogens had been discovered in most of the recent cases, he ascribed the outbreak to digestive disorders "associated with seasonal changes of food." He also suspected that spoiled canned foods investigated by the advisory hygienist had been involved as well. To prevent further occurrences he recommended that during the period when fruit was ripening a special unit be detailed to collect fruit and make it into marmalade. He further suggested that if despite this measure dysentery-like disorders reappeared, then gas-producing foods should be eliminated from soldiers' diets including pork, sauerkraut, salad, and fresh fruit. Instead, blander items such as veal, mashed potatoes, and gruel should be substituted.

While not denying the role of bacilli, many doctors argued that alimentary tract irritation caused by dietary failings such as eating immoderate quantities of fruit, unripe fruit, cucumber salad, or too much fat or drinking too much water created a predisposition among soldiers for explosive episodes of bacillary dysentery.[61] Others claimed that in many instances previously healthy soldiers reported eating stale or moldy bread, after which they suffered from stomach pains and diarrhea.[62] They concluded that consumption of spoiled bread preceded and constituted a precondition for dysentery. Despite widespread suspicion about the role of diet in precipitating dysentery outbreaks, nonetheless, as Hoffmann stated, the etiological significance of eating moldy bread or unripe fruit was never clarified in the course of the war.[63]

The second major consequence of the unreliability of bacteriological-testing-related uncertainty about etiology was that most diagnoses were made by doctors specializing in internal medicine based on clinical

60. HSTAB (KrA) AOK 6 Armee Arzt: Hygiene, Sanitäts-und Gesundheitsberichte 1914–1915: Bericht über die Sitzung der Korpsärzte und der Korpshygieniker beim Herrn Armeearzt am 17 August 1915.

61. Mayerhofer and Reuss, "Epidemiologische" (n. 44), 80.

62. Jungmann and Neisser, "Zur Klinik und Epidemiologie der Ruhr" (n. 36), 124.

63. Hoffmann, "Hygienische Erfahrungen" (n. 1), 225.

symptoms.[64] Not without a certain *Schadenfreude* given the prewar prestige of medical bacteriology and the well-established rivalry between these specialties, several distinguished clinicians asserted that "dysentery" was exclusively a clinical concept since it had no unified etiology.[65] Bacteriological and clinical concepts were incongruent. At a major conference on internal medicine held in occupied Warsaw in May 1916 Max Matthes (1865–1930), a distinguished professor of internal medicine at the University of Marburg, the author of the standard book on the differential diagnosis of enteric diseases, and an advisory internal medicine specialist to an army on the eastern front, allowed only that bacteriology had a subordinate role to play as an auxiliary science.[66] Indeed, bacteriological testing had to be integrated with and placed in the service of clinical practice. Its primary role was to assist in resolving difficult questions about differential diagnosis since cases of dysentery could sometimes be confused with paratyphoid or mild cases of cholera. At least in the case of "war dysentery," a term he invoked, when there was a consilience of evidence; when large numbers of patients presented common symptoms such as frequent bloody and mucosal stools, stomach pains, and tenesmus; when their blood tests showed leukocytosis; when their urine tests yielded positive diazo reactions; and when rectoscopic examinations revealed the pathological changes characteristic of dysentery, then clinical diagnoses could be rendered with a high degree of confidence. Thus, the difficulties encountered by bacteriologists in detecting bacilli in many cases of clinically diagnosed dysentery became an occasion for internal medicine specialists to reassert their authority.

The preponderant reliance on clinical diagnoses, however, also had tangible practical consequences. Most therapeutic regimes were nonspecific as they had been before the war. Bed rest, rehydration, and diets consisting of bland, easily digested foots such as gruel and zwieback constituted

64. HSTAB (KrA) AOK6 Bd. 250 Hygiene gesundheitssammelberichte 1914–18: Armee Arzt 6 A Hqu den 30 Januar 1918, Gesundheitsbericht des Armee Arztes 6 fuer die Monate September, Oktober, November und Dezember. Under Krieglazarette it states "Ruhr: Die Diagnose wird jetzt meisterns nur klinisch gestellt, womit man ganz gut auskommt und viel Geld und Zeit erspart." See also Alfred Schittenhelm, "Die Bazillenruhr," in *Innere Medizin*, vol. 3, ed. Ludolf von Krehl, *Handbuch der Ärztlichen Erfahrungen im Weltkriege 1914/1918*, ed. Otto von Schjerning (Leipzig: Verlag von Johan Ambrosius Barth, 1921), 143.

65. C. Hirsch, "Ueber Ruhr und ihre Behandlung im Felde," *Deutsche med. Wochenschr.* 41 (September 30, 1915): 1179–82, esp. 1179–80; and M. Matthes, "Über die Ruhr" (n. 24), 282.

66. Matthes, "Über die Ruhr" (n. 24), 289–93.

the fundamentals of treatment.[67] Clinicians certainly debated whether adsorbents such as Bolus alba, astringents such as tannin, purgatives such as calomel, or narcotics such as codeine relieved symptoms and hastened recovery. The only specific therapy was the injection of antitoxin serum.[68] Several German chemical firms manufactured both a serum to counter the toxin of the Shiga–Kruse bacillus as well as polyvalent sera that supposedly neutralized both the Shiga toxin and the weaker toxins of Flexner strains. Clinical evaluations of the efficacy of these sera, however, diverged considerably. Some of this divergence may have resulted from cases in which Shiga antitoxin was applied even though another bacillus was the pathogen. This was especially likely on the western front where most critics of serum therapy were active. There most cases of dysentery seem to have been milder and caused by Flexner strains. Other critics may have been injecting serum belatedly. Perhaps because they saw what they believed, those who doubted a bacterial etiology or were convinced that the causal agent had not been found tended to reject serum therapy.[69] Those who held that the pathogens had been identified correctly were inclined to see pronounced improvements in patients' conditions when serum treatment began early. In stark contrast to prewar understandings of the workings of antitoxin sera, a few clinicians argued that any serum, including diphtheria antitoxin, relieved dysentery symptoms. Hence, they claimed that the benefits of serum therapy were nonspecific. Disputes over the value of antitoxin therapy continued throughout the war, and although most clinicians were favorably disposed, no consensus was reached or uniform policy adopted. Because of the high doses and serum shortages, serum was injected only when cases of shigellosis had been confirmed bacteriologically or the patient appeared to be succumbing to toxemia.

A far more significant consequence of the increasing reliance on clinical diagnosis was the inability to ferret out asymptomatic carriers and the premature release of convalescents who were still passing bacilli.[70]

67. The war literature on therapy was vast. See, for example, ibid., 294–98; Hirsch, Ueber Ruhr" (n. 65), 1181–82; Schittenhelm, "Die Bazillenruhr" (n. 64), 148–52.

68. Thorough discussions of the debate over serum treatment are to be found in Schittenhelm, "Die Bazillenruhr" (n. 64), 150–52, and especially in Schittenhelm, "Über die Serumbehandlung der bacillären Ruhr," *Med. Klinik* 15 (January 12, 1919): 33–37, in which he reviewed the wartime debates and sought to make a statistical case for the efficacy of serum therapy based on data from one eastern army.

69. An example of this is Dorendorf and Kolle, "Klinische und bakteriologische Beobachtungen" (n. 51), 562, 564.

70. This is handled best in Th. Fürst, "Die Bakteriologische Kontrolle bei der Bekämpfung der Ruhr," *Feldärztliche Beilage zur Münch. med. Wochenschr.* (May 22, 1917): 693–95. See also Boehncke, "Bazillenruhr" (n. 16), 363.

Recuperating soldiers were often released prematurely because clinicians considered the role of bacteriological testing as merely confirming their diagnoses, and hence they ignored the public health implications of their practices. They were under pressure, moreover, to shorten convalescence as much as possible because of manpower demands at the front and the limited numbers of beds available in military hospitals. The prewar standard of ensuring that a patient had successfully passed three bacteria-free stool tests before being released was frequently rejected. Both carriers and shedding convalescents, however, had epidemiological significance. Not only did they perpetuate the chain of transmission at the front during months with low frequencies of dysentery incidence, but they probably played the key role in transmitting the disease to Germany as well. Testing for carriers was undertaken when an explosive outbreak erupted in a small unit, but such a response seems to have been relatively rare.[71] Thus, measures that had been central to containing dysentery outbreaks were largely neglected during the war, thereby facilitating conditions for further epidemics.

In light of failures of bacteriological testing, especially early in the war, and the consequent debates over etiology, treatment, and prevention, it is difficult to disagree with Dr. Bürger's judgment delivered soon after the war.

> Seldom have so many different opinions been expressed about a disease as about bacillary dysentery. The war literature has even produced more confusion than clarity. Not only is there a lack of clarity about the epidemiology—problems which even today haven't been resolved, but also opinions are very divided about the clinical and bacteriological concept "dysentery," the methods of treatment and prophylaxis of this disease.[72]

These confusions, however, enabled internal medicine clinicians to attempt to redefine "dysentery" as a clinical concept and to reclaim the disease for their specialty.

Hygienic Breakdowns

Prophylaxis was very much an issue since the second major reason for the failure of military hygienists to control bacillary dysentery caused by

71. HSTAB (KrA) AOK Sued. Abt. V (Armeearzt) Bd. 85 Sanitätsdienst-Berichte des Armees 1915–1917. Kaiserlich Deutsche Suedarmee A. H.Qu. 8.16 "Sanitätsbericht für die Zeit vom 1.6 bis 31.7.1916" under Infektionskrankheiten. Two hundred ninety-seven men were tested in a reserve pioneer company in which a dysentery epidemic had broken out. Forty-one were found to be passing bacilli. Thereafter, the company doctor tested the men daily and intensified the hygienic regimen.

72. Bürgers, "Über Ruhr im Felde" (n. 30), 13.

hygienic breakdowns resulted from their inability to enforce adequate latrine cleanliness, diminish the "fly plague," and in some instances secure a safe food supply. These breakdowns were more pronounced on the eastern front but also occurred on the western front especially during battles or periods of rapid troop mobility such as those at the outset and conclusion of the war. Late in the war when personnel and resources were stretched thin, hygienic lapses affected military bases and training facilities in Germany as well. As Hoffmann affirmed, the inability to maintain latrine hygiene certainly was not ascribable to lack of effort. Hygienists and other military doctors regularly admonished soldiers to cover latrines and keep the seats clean after use, use toilet paper, wash their hands, and bury their feces after defecating in the open.[73] Hygienists inspected latrines and strewed quicklime extensively.

One of the major reasons for covering latrines and burying feces was to deprive flies of the opportunities to spread pathogens mechanically. Even before the war the literature on dysentery had implicated flies as significant vectors.[74] During the war several researchers demonstrated the presence of dysentery bacilli on the feet, in the stomach canals, and in the feces of flies, thus strengthening the case for their presumed importance.[75] This case was further reinforced by the strong correlation between the seasonality of swarms of flies and the beginning and end of major dysentery epidemics. Hygienists certainly educated soldiers about the risk of infection from these insects and introduced measures to kill flies. They warned soldiers that flies were not merely nuisances but potentially dangerous vectors.[76] They urged troops to kill as many as possible and to protect their eating utensils. Fly screens and paper were available for use in field kitchens. Hygienists were acutely aware, however, of the discrepancy between the extent of the danger and the limitations of the measures at their disposal. As one hygienist stationed in Russian Poland assured his readers, "One can only have a sense of what a fly plague really is who has felt it on his own body during a campaign in Poland during the hot months and who has conducted an almost hopeless struggle against myriads of these black plague spirits."[77]

73. A dysentery prevention leaflet that was distributed to soldiers is reproduced in Boehncke, "Bazillenruhr" (n. 16), 376–77.

74. Lüdke, *Bazillenruhr* (n. 11), 196, 223.

75. Boehncke, "Bazillenruhr" (n. 16), 364.

76. HSTAB (KrA) AOK 6 Bd. 252 Armee Arzt Hygiene-Sanitäts-Gesundheitsberichte Januar-Dezember 1918. Poster "Fliegenbekämpfung" XXX res. Korps following Generalkommando 55 A.K. Abt. IV H.Qu. den 24.5.1918.

77. Koch, "Zur Epidemiologie" (n. 17), 185.

Despite the pervasive awareness of the need to practice careful latrine hygiene and take stringent measures against "the fly plague," preventive measures were often forgotten, especially on the eastern front with its rapid advances. One report from Russian Poland described the filth associated with German military occupation, although given standard German prejudices about eastern Europe the author laid much of the blame on Polish civilians.

> One can only obtain a clear picture of what a high degree of filthiness of the ground with human waste can be reached who has spent some time with troops or viewed a locality closely that has long been occupied by troops. Already among the civilian population of Poland the removal of feces and other waste leaves almost everything to be desired. The farm houses in the countryside, the villages, and even the small cities entirely lack the most primitive toilets. The inhabitants generally deposit their excrement in the vicinity of their houses. Given the lack of toilet facilities many of the troops do the same. If, however, one was available it became filthy so rapidly that even its appearance aroused disgust. If a place is occupied by troops for several days, latrine hygiene is so neglected, as happened here and there, that because of the excrement of hundreds of men, the filthiness in the vicinity of farmsteads and the locality develop into a really miserable state of affairs.[78]

Another doctor saw latrines in Poland filled almost to the brim, the seats and backboards splattered with blood and mucus and flies swarming on countless dysentery stool.[79] He added that the men seldom disinfected their hands. During battles, moreover, latrines were often destroyed and could not be repaired until fighting ended. Consequently the spread of dysentery in the east was hardly surprising.

Even in Germany at training facilities latrine hygiene was sometimes abysmal, especially late in the war. A staff doctor who inspected a training camp in Grafenwoehr, Bavaria, in response to a dysentery epidemic there wrote the following graphic account.

> Some of the latrines don't fulfill the hygienic demands that orderly facilities of this type are supposed to. There were latrines that were overflowing the rim with feces. Mixtures of straw showed that this was sometimes used instead of toilet paper. The disinfection of latrines with quicklime was also in no way satisfactory. Larvae of flies existed in many latrines. Their existence showed that one certainly can't speak of killing infectious germs. The insects that crawled out were found in great numbers in a kitchen that lay nearby, the window of

78. Ibid., 184.
79. Bürgers, "Über Ruhr im Felde" (n. 30), 25.

> which was broken, which provided rich opportunities for the transport of infectious materials onto the food that was stored there. A replacement fly-secure window for the broken one hadn't been ordered.[80]

As both this passage and the earlier discussion of widespread suspicions about the role of spoiled food in dysentery outbreaks suggest, the food supply was often vulnerable as well. Thus, for example, in January 1918 an epidemic coursed through a battalion being trained near Erfurt, Germany.[81] During the following two months 401 men in the unit were diagnosed with shigellosis. This epidemic was traced ultimately to infected potato salad. It was finally extinguished by reviving prewar measures including isolating the sick and disinfecting their belongings, closely observing those who had been in immediate contact with them, and canceling leaves to confine the disease to the base. This was a case in which the food was found to harbor dysentery bacilli, but presumably many of the summer epidemics in which military doctors perceived a causal connection between diet and dysentery may well have been attributable to food infected by either flies or asymptomatic carriers among kitchen personnel.

What such incidents clearly show is that despite the best efforts of military doctors, hygiene was insufficient to prevent enteric diseases whether at the front or even in Germany itself. Based on his own experience Ernst Friedberger (1875–1932), an immunologist at the University of Greifswald who had served as a hygienist in a reserve division on the western front during 1914–15, attributed the decline in incidence of both typhoid and cholera after the early months of the war to improved hygienic measures that came with the stabilization of the front rather than to vaccines.[82] But as many military hygienists, including Hoffmann, pointed out, it was highly doubtful that his limited experience could be universalized.[83] The rising incidence of bacillary dysentery throughout the war undermined his

80. HSTAB (KrA) Mkr 10083 Ruhr: Stabarzt Prof. Dr. Weichardt, 28 Aug. 1917 "Gutachten Betreff Ruhr an das K. Sanitätsamt III A.K. Nürnberg.

81. Abel and Loeffler, "Eine Ruhrepidemie von explosivem Charakter, hervorgerufen durch ein infiziertes Nahrungsmittel," *Zeitschr. für Hygiene und Infektionskr.* 87 (1918): 410–28.

82. Ernst Friedberger, *Zur Entwicklung der Hygiene im Weltkrieg* (Jena, Germany: Verlag von Gustav Fischer, 1919). His thesis is stated most forcefully on 26. Friedberger's critique of the claims for typhoid and cholera vaccines appears on 27–104; his account of the role of general hygienic provisions in reducing infectious diseases appears on 105–57.

83. Wilhelm Hoffmann, "Cholera," in Hoffmann, *Hygiene* (n. 16), 398–403 and Hoffmann, "Hygienische Erfahrungen" (n. 1), 215–18.

claim that hygienic measures alone had sufficed to account for the waning significance of typhoid and cholera. Indeed, on the far more mobile eastern fronts, with their swarms of flies and where dysentery had been endemic among civilian populations before the war, hygienic conditions among German troops were frequently glaringly defective. During the last war years there is evidence of serious hygienic lapses in Germany as well when the general health of both the military and civilian populations was deteriorating due to food shortages and the strains of a prolonged war, thereby heightening susceptibility to dysentery. Thus, Hoffmann's critique of Friedberger's emphasis on the primacy of hygiene in controlling enteric diseases certainly seems to have been vindicated.

A Belated Vaccine

The third reason for the difficulty in controlling bacillary dysentery was the lack of a vaccine early in the war. Whereas Pasteur-type vaccines composed of heat-killed typhoid and cholera bacilli were instrumental in halting cholera and typhoid epidemics that struck German armies in 1914–15 and in minimizing morbidity for the remainder of the war, no comparable dysentery vaccine was available.[84] As previously mentioned, both Shiga and Kruse had sought to develop a vaccine before the war. But Kruse had abandoned this quest because of both the diminished incidence of dysentery in Germany and the severity of adverse reactions in preliminary tests. During the war Kruse remained skeptical about the prospects for a successful vaccine.[85] Nonetheless, he once more attempted to generate an anti-Shiga vaccine, but again he abandoned the project because of intense reactions of experimental subjects. Since there were so many strains of "pseudo-dysentery" bacilli, he held that formulating a reliable vaccine against these pathogens was precluded. Precisely because of the manifest failures of hygienic control and the resulting massive dysentery epidemics among German troops in the east, in fall 1916 Dr. Karl Boehncke and his coworkers in a field laboratory in the east began collecting multiple strains of dysentery bacilli and conducting tests on animals

84. Hünermann, "Über Typhusschutzimpfung," in His and Weintraud, *Verhandlungen* (n. 12), 203–30; and Hoffmann, "Schutz des Heeres gegen Cholera," 17–42 in the same volume. For debates over typhoid vaccine within the German medical corps see Derek S. Linton, "Was Typhoid Inoculation Safe and Effective during World War I? Debates within German Military Medicine," *J. Hist. Med. & Allied Sci.* 55 (2000): 101–33. For a survey of vaccines during World War I see Arthur Allen, *Vaccines: The Controversial Story of Medicine's Greatest Lifesaver* (New York: Norton, 2007), 133–36 for typhoid vaccines.

85. Kruse, "Über die Ruhr" (n. 12), 314–15.

in the hope of creating just such a polyvalent vaccine.[86] Boehncke came to this project with considerable relevant experience. Before the war he had headed the bacteriological laboratory of an army corps where he had carried out research on standardizing dysentery antitoxin serum. Based on promising initial results with the new vaccine, Boehncke secured the permission of the Prussian War Ministry to collaborate with the private Ruete/Enoch Serumwerke in Hamburg. After trying many variants, by early 1917 Boehncke and his associates had readied a vaccine consisting of both Shiga–Kruse bacilli and many strains of pseudo-dysentery bacilli from eastern Europe killed with carbolic acid at 37° C. To prevent the severe reactions to Shiga toxin that had discouraged Kruse from persevering, they added toxin partially neutralized with antitoxin. Thus, this vaccine, which was named Dysbakta, combined the Pasteurian approach embodied in typhoid and cholera vaccines with the toxin–antitoxin mixture pioneered by Emil von Behring (1854–1917) in creating his TA vaccine against diphtheria.

In early 1917 German military doctors began testing Dysbakta for safety on prisoners in occupied Lithuania.[87] Since there were few adverse reactions, it was approved for wider use the following summer. Inoculations were carried out in Russia, the Baltic States, and other captured territories in the east whenever an epidemic broke out, rather than purely prophylactically.[88] About 100,000 people were inoculated, testimony to the military medical corps's administrative capacity even late in the war, especially since the vaccine had to be injected three times several days apart. About half of those receiving the vaccine were German soldiers or health workers and the other half were civilians under occupation. Since no safety level had been established for children, those under four were supposed to be excluded, but in some places this precaution seems to have been ignored. Some batches of the vaccine were clearly defective, including ones in which the toxin–antitoxin component had not been standardized and ones in which the vaccine was not sterile.[89] But these

86. Boehncke, "Ruhrschutzimpfung im Kriege," *Med. Klinik* 41 (October 14, 1917): 183–84; and Boehncke, Hamburger, and Schelenz, "Untersuchungen über Ruhrimpfstoffe in vivo und vitro," *Berliner Klin. Wochenschr.* 55 (February 11, 1918): 134–37.

87. Karl Boyé, "Ruhrbekämpfung durch Schutzimpfung mit Dysbakta-Boehncke," *Münch. Med. Wochenschr.* 65 (August 27, 1918): 961–62.

88. Boehncke and Elkeles, "Ruhrschutzimpfung mit Dysbakta," *Münch. Med. Wochenschr.* 65 (July 16, 1918): 785–87.

89. Wilhelm Hoffmann, "Über Ruhrschutzimpfung," *Deutsche Militärärztliche Zeitschrift* 47 (1918): 234–35. This article was based on a paper Hoffmann delivered to the Scientific Senate of the Kaiser Wilhelm Academy in Berlin in April 1918. The senate deliberated over whether new medical procedures should be introduced and made recommendations to the director of field sanitary services Otto von Schjerning.

inoculations generally confirmed the safety of the vaccine. Dr. Bischoff, an advisory hygienist to an army in the east, reported on the reactions of over four thousand German soldiers and five hundred POWs.[90] Only soldiers who appeared to be sick or who registered elevated temperatures were excused. Over 98 percent of those inoculated had either no reactions or mild localized ones, whereas the remainder had slightly raised temperatures. The only exceptions to these pervasively mild reactions occurred in one sanitary company in which many members complained of exhaustion, dizziness, and headaches and one machine gun company in which many soldiers vomited after vaccination. Bischoff suspected that in the sanitary unit many were already in the incubation stage of dysentery since many had already been stricken with dysentery or other stomach disorders. The reactions in the machine gun unit apparently had nothing to do with the vaccine but instead were coincidental. The vomiting was traced to sauerkraut cooked in a zinc-coated iron pot from which the zinc was leeching off. Few POWs or medical personnel voiced complaints about adverse reactions. Hence, reactions to Dysbakta were comparable to those to typhoid or cholera vaccines, and no evidence suggested lasting harm. Nor was the fighting capacity of troops impaired following vaccination, a key military consideration.

Although there were no formal controls, in a kind of natural experiment military doctors monitored civilian morbidity and compared rates in villages in which the inhabitants were vaccinated to those in which the residents were not. One Dr. Steuernagel, who carried out fifteen thousand inoculations of civilians in the east, stated that during one epidemic morbidity dropped 21 percent in twenty days following vaccination and the mortality rate fell 65 percent.[91] By contrast in neighboring villages where vaccination was not implemented morbidity and mortality rates were unaltered. According to Bischoff the vaccine made latent cases manifest, and soldiers who were transferred or went on leave before receiving all three doses sometimes caught dysentery, but most of those who completed the course of injections acquired immunity.[92] Those involved with the dysentery vaccine program had the impression that severe cases virtually disappeared and mild cases were preponderant. These could be

90. H. Bischoff, "Erfahrungen mit dem Ruhrschutzimpstoff Dysbakta (Boehncke) bei der Ruhrbekämpfung," *Zeitschr. für Hygiene und Infektionskrankheiten* 87 (1918): 315–42, esp. 322–40.

91. Steuernagel, "Ruhrschutzimpfung mit Dysbacta-Boehncke," *Deutsche Med. Wochenschr.* 44 (March 21,1918): 317.

92. Bischoff, "Erfahrungen" (n. 90), 327–28, 336–41.

treated successfully by a few days of bed rest and bland diets. Even during battles in September 1917 there were only scattered cases of dysentery rather than an epidemic despite deteriorating hygienic conditions and interrupted food supplies. Bischoff doubted that the vaccine conferred absolute immunity, but he was convinced that like the cholera and typhoid vaccines it did offer substantial relative immunity. Boehncke agreed that immunity was not absolute, but he claimed that Dysbakta reduced morbidity rates substantially and came close to eliminating fatalities.[93] Most of the early evaluations were equally positive. Although the question of how long the vaccine remained effective was unresolved, it seemed to work for the entire summer, sufficiently long to prevent major epidemics. Nonetheless, troops would have to be inoculated annually as they were with typhoid vaccine. Based on their observations fifty military doctors participating in the initial field trials recommended that Dysbakta be deployed prophylactically on a large scale, whereas only three opposed this.[94] Bischoff cautioned that a final judgment could not be rendered without more extensive trials, and he recommended maintaining carefully updated cards on those vaccinated and that analysis of the resulting data be centralized.[95] Nonetheless, he endorsed Dysbakta without reservation as a "beneficial prophylactic measure" that should be made obligatory during the summer of 1918 especially since hygienic measures had not brought success against dysentery. Hoffmann also extended his qualified endorsement to the vaccine pending further research on its efficacy.[96]

In light of these preliminary results and recommendations in May 1918 the Prussian War Ministry approved Dysbakta for inoculating troops during dysentery epidemics.[97] During the final phase of the war it seems to have been applied in the east and in at least one local epidemic within Germany, but not on the western front.[98] Whether Dysbakta actually contributed to the decline of incidence in the east during the summer of 1918 and, if so, to what degree remain open questions. Fighting largely ceased following the peace treaty with Bolshevik Russia, and hence hygiene could be ameliorated among occupying troops. Moreover, large numbers of

93. Boehncke and Elkeles, "Ruhrschutzimpfung mit Dysbakta" (n. 88), 786–87.

94. Ibid., 787.

95. Bischoff, "Erfahrungen" (n. 90), 341–42.

96. Hoffmann, "Über Ruhrschutzimpfung" (n. 89), 238.

97. HSTAB (KrA) Mkr 10083 Ruhr: Kriegsministerium Sanitäts-Departement Berlin 30.5.1918 an das Königlich Bayerische Kriegsministerium Medizinal Abteilung München. Signed by Schultzen.

98. Abel and Loeffler, "Eine Ruhrepidemie" (n. 81), 419–20.

German troops were transferred to the west for the spring offensives to shore up the collapsing front. Given its belated and limited application, there can be little doubt that Dysbakta achieved relatively little in terms of reducing dysentery among either German troops or civilians in the east. Indeed, the lack of a vaccine until late in the war was clearly the single most important explanation for the contrast between the incidence of cholera and typhoid, which declined rapidly after mass inoculation began in fall 1914, and the rising incidence of dysentery throughout the war.

Were Outbreaks of Bacillary Dysentery "War Epidemics"?

In a recent article titled "Of War and Epidemics: Unnatural Couplings, Problematic Conceptions," the English medical historian Roger Cooter sought to "denaturalize" the concept of "war epidemic" and asserted that this coupling and its naturalistic interpretation have constrained the imaginative capacities of historians.[99] His article largely consisted of an intellectual history of the juxtaposition of war and epidemics in Britain from the early nineteenth century until the 1940s, which exposed the multiple interests and agendas the concept of "war epidemics" served from those of *laissez-faire* political economists committed to *pax liberalis*, to sanitarians like Florence Nightingale dedicated to army medical reform after the Crimean War, to bacteriologists, epidemiologists, and demographers intent on promoting their emerging disciplines as powerful bodies of knowledge capable of contributing decisively to national efficiency and, thereby, advancing the national interest.[100] In exposing the coupling of war and epidemics as a socially constructed discourse and alerting us to complex functions and skeins of interest that have often shaped this coupling, Cooter performed a valuable service. As we have seen German discourses about dysentery during the war expressed a variety of professional and political interests as well. For Frey, the German medical administrator in Russian Poland, occupation policies to combat dysentery justified imperial expansion and Germany's civilizing mission. For many clinicians the discussion of "war dysentery" with the implication that it differed in significant ways from dysentery in peacetime and perhaps had a distinctive etiology was a way of reasserting the primacy of clinical medicine and relegating bacteriology to a subsidiary role as an auxiliary science. For some bacteriologists the emphasis on "war dysentery" called

99. Cooter, "Of War and Epidemics" (n. 7), 283.
100. Ibid., 289–300.

attention to the insuperable handicaps under which they labored and offered a kind of ready-made excuse for their diagnostic difficulties and failure to keep epidemics from spreading not only within the military but also among civilians within Germany.[101] For them dysentery epidemics became a virtually inevitable concomitant of exceptional wartime conditions and the operation of German troops under conditions of hygienic neglect pervasive in eastern Europe and Russia, a theme that also reinforced prewar prejudices against Russians, Poles, and Jews. Exposing the interests served by a conceptual linkage neither discredits the linkage nor addresses the phenomena to which it refers. Obviously it was the unanticipated emergence of major dysentery epidemics that compelled clinicians, hygienists, and medical administrators to deploy the concept of "war dysentery" in a variety of self-interested ways since, after all, they legitimated their authority on the basis of their abilities to safeguard the health of Germany's soldiers and civilians.

Although Cooter explicitly eschewed "engaging in debate over pathogenic 'realities,'" implicitly a four-page section titled "Historical Empiricism, Pathogenic Realism" sought to undermine the supposedly rigid distinctions between peace and war, endemic and epidemic diseases and, thereby, further attempted to cast doubt on the linkage between war and epidemics.[102] This section concluded by asserting,

> Thus, even if we were able to construe war as a discrete event, we ought not to over-estimate its importance, for war itself is woven within wider, more densely knit demographic/pathogenic and socio-political systems. In effect, to talk about epidemics in relation to wars is falsely to objectify the reality of both, detaching them from their social and political moorings.[103]

The arguments presented in this section, however, are not particularly persuasive. First, he pointed out that there are wars without epidemics and epidemics without wars and "that not all potentially epidemic diseases are necessarily rendered exceptionally virulent as a result of war."[104] There are two distinct issues here, neither of which counts against linking wars and epidemics. The existence of epidemics during years of peace in no way calls into question the causal linkage between specific epidemics and wartime conditions, although obviously this linkage must be shown rather than assumed. In the case of bacillary dysentery during World I it

101. Boehncke, "Bazillenruhr" (n. 16), 371–72.
102. Cooter, "Of War and Epidemics" (n. 7), 285–88, 301.
103. Ibid., 288.
104. Ibid., 285.

is relatively easy to establish the association. As shown above there was a clear relation between hygienic conditions on the eastern front and the emergence of major clusters of bacillary dysentery within the German military. Cases of German soldiers returning from the east on leave and infecting family members and neighbors were well documented. Given the rapid decline of bacillary dysentery within Germany in the prewar years, it is virtually unimaginable that an epidemic like the one of summer 1917 would have occurred without the presence of German armies in eastern Europe. Nor was bacillary dysentery an isolated or unique example. In a recent monograph on the conquest of malaria in twentieth-century Italy Frank M. Snowden demonstrated that for a variety of reasons ranging from major cutbacks in the government campaign against malaria in order to shift funding to the war effort, to shortages of quinine, to the return of Italian soldiers infected with malaria in Macedonia, in Italy the First World War "unleashed a measureless and ever-deepening malaria problem, reversing the gains of twenty years of unceasing toil."[105] Likewise a number of recent studies have closely related the war to the influenza pandemic of 1918–19 from the crowded army camps in France where the virus originally may have mutated and became so lethal to the "use of the expanded and more intensively utilised transportation network occasioned by the war."[106] As Patrick Zylberman has argued about the influenza epidemic in France, "[B]y mustering an enormous number of men on the front or in the rear, by crowding trains with soldiers going on leave, by moving and displacing people, the war broke down defenses against contagion. The transport infrastructure helped to 'virally equalise' all categories, civilian and military, and all geographical areas." Smallman-Raynor and Cliff have mapped war-specific troop movements and traffic patterns in Serbia in relation to the spread of the typhus epidemic of 1914–15 that resulted in 120,000 military and civilian deaths.[107] Examples could certainly be multiplied.

105. Frank M. Snowden, *The Conquest of Malaria: Italy, 1900–1962* (New Haven, Conn.: Yale University Press, 2006), 115–36, quotation on 134.

106. Patrick Zylberman, "A Holocaust in a Holocaust: The Great War and the 1918 'Spanish' Influenza Epidemic in France," in *The Spanish Influenza Pandemic of 1918–19: New Perspectives*, ed. Howard Phillips and David Killingray (London: Routledge, 2003), 191–201, this quotation and the following one on 199–200. The virologist John S. Oxford has suggested that the influenza virus may well have mutated in Etaples, France, during the winter of 1916 due to camp conditions there. John S. Oxford, "A Virologist's Foreword," in the same volume, xvii–xix.

107. Smallman-Raynor and Cliff, *War Epidemics* (n. 9), 657–64.

The fact that "not all potentially epidemic diseases are necessarily rendered exceptionally virulent as a result of war" is a red herring. To my knowledge no one has ever claimed that all potentially epidemic diseases become more virulent during wars. The fact that some infectious diseases do not become exceptionally virulent during wartime does not call into question the causal relation between specific epidemics and war-related conditions that facilitate them, such as unhygienic camps or crowded trenches. It is surely not astonishing that dysentery, malaria, epidemic typhus, and STDs became more pervasive and virulent during World War I.

Second, Cooter argued that "the causal connection between war and epidemics has been further challenged, if indirectly, through the study of nutrition in relation to disease."[108] Historians previously viewed war as a "predisposing culprit as a result of precipitating famine and malnutrition," whereas a number of recent studies have demonstrated that nutritional status matters little for susceptibility to many infectious diseases, including plague, and has variable significance for influenza and typhus.[109] Bacillary dysentery, however, like cholera and tuberculosis, numbers among those diseases for which susceptibility is strongly affected by nutritional status, as many doctors during World War I suspected, thus reinforcing the claim that the epidemics examined here were indeed war epidemics.[110]

Third, and more fundamentally, he considered the relation problematic because of the way we define "war" and "epidemic disease." Cooter blurred the distinction between peace and war by avowing that "although Western society was by no means in a state of constant war in the period between the Crimean and the Second World War, it was . . . increasingly 'militarized' in terms of state policy, organizational structures, values, and modes of thought."[111] There is considerable truth to this observation, and indeed the "social militarization" of Germany in the prewar years, which encompasses phenomena from the importance of reserve officer status to educated middle-class males to war games engaged in by youth groups to such popular organizations as the Navy League and Army League, has been thoroughly studied and is a well-entrenched subject within the

108. Cooter, "Of War and Epidemics" (n. 7), 286.

109. Ibid., 286.

110. An introduction to the controversial relation between infectious diseases and nutritional status is provided in Massimo Livi-Bacci's *Population and Nutrition: An Essay in European Demographic History* (Cambridge, UK: Cambridge University Press, 1991), 35–39.

111. Cooter, "Of War and Epidemics" (n. 7), 287.

historiography of Imperial Germany.[112] This militarization undoubtedly facilitated the mobilization of German society from 1914 to 1918. Nonetheless, the war itself constituted a sharp rupture as contemporaries understood. For military hygienists there was a sharp break between serving on a quiet base during peacetime or as a municipal public health official concerned about school hygiene or campaigns against STDs and the maelstrom of war at the front, where diseases previously of marginal significance or unknown such as epidemic typhus, dysentery, and "trench fever" came to the fore.[113] There were certainly some continuities as well. German public health officials had conducted major campaigns against STDs and typhoid before 1914, and these remained major concerns during the war as well. These few continuities, however, surely do not suffice to eliminate or even blur the distinction between peace and war.

Cooter also effaced the boundary between endemic and epidemic diseases. His points are well taken that "'epidemics' can be both pathogenetically and socio-politically relative" and that they can mean different things to different people, but again this doesn't discredit the notion that wars have frequently created conditions that favored the spread and increased mortality from specific infectious diseases.[114] Despite his claim, associating wars and epidemics does not suggest that "*non*-war-time demographic regimes are static."[115] One of the major reasons for considering the outbreaks of bacillary dysentery in Germany as war epidemics is precisely because of the rapid decline of the disease in the decade before the war. The war reversed a well-established and far from fortuitous peacetime trend, as it did for malaria in Italy. Nor does discussing epidemics in relation to war necessarily "objectify the reality of both, detaching them from their social and political moorings," since the spread of bacillary dysentery during the war is incomprehensible without understanding German military policy and social conditions within eastern Europe and Germany.[116] Our imaginations would be far more constrained if we failed to realize

112. See, e.g., Hans-Ulrich Wehler, *Deutsche Gesellschaftsgeschichte: III Von der "Deutschen Doppelrevolution" bis zum Beginn des Ersten Weltkrieges, 1849–1914* (Munich: Verlag C. H. Beck, 1995), 880–85.

113. This break certainly emerges clearly in the medical memoir literature. See, e.g., the memoir of the Koch student and typhoid specialist Wilhelm v. Drigalski, *Im Wirkungsfelde Robert Kochs* (Hamburg: Hans Dulk, 1948), especially his chapters on his work in founding the municipal health office in Halle before the war and his accounts of his activities as an advisory hygienist during the war, 347–83 and 440–56.

114. Cooter, "Of War and Epidemics" (n. 7), 288.

115. Ibid.; italics in original.

116. Ibid.

the ways in which the world wars of the twentieth century fundamentally altered both the demographic/pathogenic and sociopolitical systems in which they were woven. The upheaval of war on the eastern front, the Austro-German invasion of Russian territories, the movement of troops and the return of soldiers to Germany on leave, the uprooting of civilian populations and their interactions with German troops all created a new relation between populations and pathogens and marked a discontinuity that constituted the preconditions for what contemporaries rightly recognized and characterized as epidemics of "war dysentery." When at the end of the war Karl Boehncke declared that bacillary dysentery had not only confirmed but also surpassed its old, evil reputation as one of the most feared war epidemics and that "it was the *real war epidemic* of the world war," he was certainly voicing a self-promoting discourse that called attention to his contributions in developing a vaccine but simultaneously describing an often fatal pathogenic reality.[117]

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117. Boehncke, "Bazillenruhr" (n. 16), 360; italics in original.